August 23, 2021

TO: A. Byrd, P.E., and R. Washabaugh, P.E.
South Central Region

FROM: A. Fiske, P.E. AF and Mike Schmitz, P.E.
HQ Geotechnical Office

SUBJECT: I-90, MP 64.48-70.60, XL-5479
I-90 Cabin Creek Interchange to West Easton Interchange Phase 3 – Add Lanes and Wildlife Bridges Project
Geotechnical Recommendations

INTRODUCTION

At the request of the South Central Region (SCR), this technical memorandum provides geotechnical recommendations for grade separation barriers and moment slab barriers associated with the subject project.

This memorandum is one of a series of technical memoranda prepared for specific design elements of the I-90 Cabin Creek Interchange to West Easton Interchange Phase 3 – Add Lanes and Wildlife Bridges Project (Project). Each technical memorandum will be incorporated into the final Project geotechnical report as an appendix. The Project geotechnical report will include detailed information regarding the site and soil conditions and will reference the Project Geotechnical Data Report (GDR), which serves as a central repository for all geotechnical data (i.e., boring logs, laboratory test data, etc.). The GDR contains detailed information regarding the geotechnical investigation performed for the Project.

PROJECT OVERVIEW

The subject I-90 Cabin Cr I/C to W Easton I/C Phase 3 - Add Lanes Wildlife Bridges project (Project) will widen I-90, straighten curves, stabilize rock slopes, and connect wildlife habitat between approximately MP 64.48 and MP 70.60.

The grade separation barriers involved in Phase 3 of the Snoqualmie Pass East Project are located along an approximate mile-long section of I-90 between mileposts 65.3 and 66.3. A site vicinity map is shown in Figure 1. Along the length of the project site, current grades will mostly be raised and a Mechanically Stabilized Earth (MSE) wall (which is not discussed in this memorandum) will be constructed on the south side of the road to accommodate the road widening. Differential barriers separating the eastbound and westbound lanes will generally rest on native soils or existing fill. In some areas, the elevation of the barrier foundation will be higher than the existing ground surface and the barriers will rest on newly imported fill. Grade barrier sections will consist of cast-in-place concrete F-shaped barriers. Additionally moment slabs will be constructed at various bridge locations along the project extents.

GEOTECHNICAL INVESTIGATION

The geotechnical investigation associated with the Project was planned, coordinated, and managed by WSDOT. The field investigation consisted of a series of subsurface explorations that were completed along the project alignment between October 2016 and October 2020. This work included subsurface test borings, groundwater monitoring, and laboratory testing. Test pits were excavated in several borrow areas during September 2019 to evaluate *in situ* moisture conditions. In addition, historic subsurface information from 1992 to 2016 was reviewed and incorporated into the geotechnical investigation. Please refer to the GDR for a detailed description of the geotechnical investigation.

SUBSURFACE CONDITONS

Soil Conditions

Subsurface information from 21 borings was used to develop the geotechnical recommendations for the Grade Separation Barriers. The locations of the borings are shown in Exhibit 1. The location of these explorations relative to the proposed differential barriers are shown on the Differential Barrier – Plan and Profile Sheets included in Attachment A.

EXHIBIT 1: SUMMARY OF FIELD EXPLORATIONS

Boring Name	Northing[1] (feet)	Easting[1] (feet)	Surface Elevation[2] (feet)	Borehole Depth (feet)
H-15P-16	710,649.9	1,446,790.1	2,533	51
H-18-16	710,422.0	1,446,918.0	2,531	61
H-19-16	710,311.0	1,446,702.0	2,477	41
H-20-16	710,114.7	1,447,148.3	2,544	46
E-07P-18	708,029.7	1,448,950.7	2,540	35
W-06P-18	707,824.1	1,448,912.0	2,504	50
AMB-5-07	707,813.9	1,448,995.5	2,539	59
W-07P-18	707,668.5	1,449,050.3	2,490	65
W-08P-18	707,533.6	1,449,229.6	2,492	50
W-09P-18	707,398.2	1,449,415.7	2,494	49
H-25p-16	707,591.6	1,449,274.6	2,538	31
H-27-16	707,348.0	1,449,723.0	2,530	81
W-10P-18	707,281.1	1,449,707.6	2,490	80
W-11P-18	707,225.4	1,449,935.4	2,504	79
E-08-18	707,381.6	1,450,053.7	2,543	11
H-29-16	707,237.4	1,450,115.8	2,550	66
W-20-20	707,966.0	1448,864.2	2,541	81.5
W-21-20	707,729.9	1,449,094.8	2,539	60.5
W-22-20	707,543.1	1,449,299.6	2,531	50.5

Boring Name	Northing[1] (feet)	Easting[1] (feet)	Surface Elevation[2] (feet)	Borehole Depth (feet)
W-23-20	707,488.6	1,449,451.0	2,537	71.5
W-24-20	707,411.4	1,449,617.4	2,538	66.5

Notes:
1 Coordinates in Washington State Plane South
2 Elevation in NAVD88

Please refer to the GDR for a discussion of regional and site geology, a description of the existing alignment, detailed descriptions of the Engineering Stratagraphic Units (ESUs), test boring logs, laboratory test data, groundwater monitoring data, geophysical exploration data, discontinuity mapping, and laboratory testing associated with this portion of the subject project.

The subsurface information used for this study represents conditions at discrete locations across the project site and actual conditions in other areas could vary. Furthermore, the nature and extent of any variations may not become evident until additional explorations are performed or until construction begins. If significant variations are observed at that time, we may need to modify our conclusions and recommendations accordingly to reflect actual site conditions.

Along the extents of the grade barriers, three ESUs were encountered at or near the surface, as described in the GDR and summarized below.

- **ESU 1:** Existing Fill. ESU 1 generally consists of silty gravel, silty sand, silty sand with gravel, and well-graded to poorly-graded gravel. Boulders and cobbles are common, especially as shot-rock side-cast fill on the slopes of embankments. Standard Penetration Tests blow counts (SPT-N) in ESU 1 averaged 25 blows per foot, but varied widely. This wide variation in N-field values within ESU 1 is attributed to variation in materials, variation in compaction methods, and local skewing of N-values due to the abundance of coarse-sized particles.
- **ESU 2C:** Colluvium. This unit generally consists of silty gravel with sand, silty sand with gravel, and sand with silt and gravel. Cobbles, tree roots, and other small woody debris are common. SPT-N in ESU 2C along the Grade Separation Barriers averaged 14 blows per foot and ranged between 3 and 35 blows per foot. Blow counts may have been skewed higher by the presence of coarse-sized particles.
- **ESU 4A:** Alpine Glacial Outwash. ESU 4A is generally characterized as well-graded gravel with sand, poorly-graded sand with gravel, and silty sand with gravel. SPT-N in ESU 4B averaged 20 blows per foot and were generally between 5 and 40 blows per foot. Blow counts may have been skewed higher by the abundance of coarse-sized particles.

For purposes of design and construction of the grade barriers, we have grouped ESUs 1, 2C, and 4A together. These three soil units are commonly encountered at the subgrade level of the grade barriers and have similar engineering properties.

Borings along the grade barrier alignment encountered bedrock between 3 and 70 feet below ground surface (bgs). While bedrock was found at shallow depths in some areas, it was not encountered near the median, where the grade separation barriers are planned. It is therefore not expected that construction of the grade barriers will include excavation into bedrock and no barriers are expected to rest on bedrock. Borings generally encountered loose to medium dense soil (ESU 2C) near the surface, underlain by medium dense to very dense soils (ESUs 4A and 4B) over bedrock. Several borings along the barrier alignment encountered fill (ESU 1) at the surface. One boring, AMB-05-07 near station LW 1772, encountered fill to approximately 40 feet bgs.

Groundwater

In order to determine the groundwater level at the time of drilling, bailing tests were performed after each boring. Furthermore, open standpipe piezometers were installed in ten of the borings. Each piezometer was instrumented and water level readings recorded periodically. Water level information will be included in the GDR. Data collected between October 2018 and June 2020 indicate that the water levels vary between an elevation of 2531 and 2451 feet along the grade barrier alignment, often fluctuating by several feet depending on the season. Groundwater was encountered in several borings along the grade barrier alignment. Groundwater elevations near the west end of the grade barrier alignment ranged from 2513 to 2537 feet and on the east end ranged from 2497 to 2463 feet.

It is likely that perched groundwater will be encountered in areas where bedrock is shallow. Note that fluctuations in groundwater levels may occur due to variations in rainfall, temperature, seasons, and other factors. The contractor should be prepared to deal with perched groundwater encountered in excavations.

SITE SEISMICITY AND GEOLOGIC HAZARDS

Seismic Design Parameters

The ground shaking hazard can be defined in general terms using an appropriate acceleration response spectra and site coefficient, or by using a site-specific procedure.

In the general procedure, the spectral response parameters are determined using the 2014 Seismic Hazard Maps produced by the U.S. Geological Survey depicting probabilistic ground motion and spectral response for 7 percent probability of exceedance in 75 years.

Based on the criteria presented by American Association of State Highway and Transportation Officials (AASHTO) Guide Specifications for Load and Resistance Factor Design (LRFD) Seismic Bridge Design (AASHTO Guide Specification) and further analysis, we classified the site soils as Class D. Therefore, the general procedure shall be followed. In accordance with AASHTO Guide Specification, the coefficients provided in Exhibit 2 shall be used.

EXHIBIT 2: SEISMIC DESIGN PARAMETERS

Parameter	Recommended Value
Site Class Based on Soil Conditions	Site Class = D
Mean Magnitude	6.72
Peak Ground Acceleration (PGA) Coefficient of Class B Rock	PGA = 0.24g
0.2-Second Period Spectral Acceleration Coefficient on Class B Rock	S_s = 0.53g
1.0-Second Period Spectral Acceleration Coefficient on Class B Rock	S_1 = 0.16g
Site Coefficient for the Peak Ground Acceleration Coefficient	F_{pga} = 1.37
Site Coefficient for 0.2-Second Period Spectral Acceleration	F_a = 1.38
Site coefficient for 1.0-Second Period Spectral Acceleration	F_v = 2.28
Effective Peak Ground Acceleration Coefficient (g)	$A_s = F_{pga}*(PGA)$ = 0.32g
Design Earthquake Response Spectral Acceleration Coefficient at 0.2-Second Period	$S_{DS} = F_a*S_s$ = 0.73g
Design Earthquake Response Spectral Acceleration Coefficient at 1.0-Second Period	$S_{D1} = F_v*S_1$ = 0.36g

Geologic Hazards

Potential seismic geologic hazards include: liquefaction, lateral spreading, flow failure, fault rupture, and landslides. We have evaluated the existing and proposed site topography, soil conditions, and groundwater conditions and consider the risk of these geologic hazards at this site to be low.

GEOTECHNICAL RECOMMENDATIONS

This section of the memorandum presents our conclusions and recommendations for the geotechnical aspects of design and construction on the project site. We have developed our recommendations based on our current understanding of the project and the subsurface conditions encountered by our explorations. If the nature or location of the grade barriers or other aspects of the project are different than we have assumed, we should be notified so we can change or confirm our recommendations.

Grade Barrier Foundation Bearing

In general, ESUs 2C and 4A are suitable to support the grade barriers. These are the soil units identified at the proposed barrier elevations in most borings.

ESU 1 (Fill), which was identified in several borings along the grade barrier alignment, generally appears to be suitable to support grade barrier foundations; however, variability in fill material and density may affect suitability. When encountered, the existing fill should be assessed by a geotechnical engineer to determine its suitability as foundation subgrade and if any over-excavation is necessary. For planning purposes, we recommend assuming that existing subgrade fill will need to be over-excavated by 3 feet and replaced with Common Borrow fill within up to half of the grade barrier alignment. This Common Borrow fill material should be placed in accordance with Method C, per WSDOT Standard Specification 2-03.3(14)C.

In some areas, the base of the grade barriers will be above current ground surface and therefore will rest on new fill. In other cases cuts will be made into the existing slope to accommodate an MSE wall, and these cuts may extend below the proposed grade barrier locations. In both cases, the grade barriers will rest on new fill, which will likely be borrow material from cuts along the project alignment. Per the project Geotechnical Report, anticipated borrow sources will not provide a durable aggregate source, but the material is expected to meet Common Borrow specifications. This Common Borrow fill material should be placed in accordance with Method C, per WSDOT Standard Specification 2-03.3(14)C.

Grade barrier bearing elevations assumed for our recommendations are based on the plan sheets titled “Differential Barrier – Plan and Profile” prepared by WSDOT dated August 14, 2020 (included as Attachment A), as well as communications with the project team. The footing elevations of the grade separation barriers range along the roadway from 2512 feet to 2546 feet.

The barrier footings are generally expected to bear on ESU 2C and Common Borrow fill. However, at some points along the roadway, barrier footings are likely to bear on ESUs 1 and 4A. Exhibit 3 summarises our recommended resistance factors for all soil units. Our recommended nominal and 1-inch Service Limit State bearing resistances are presented in Exhibits 4 and 5, respectively, for footing widths ranging from 2 to 10 feet. The resistance values provided in Exhibits 4 and 5 assume the footing heel is embedded a minimum of 3 feet due to frost penetration.

EXHIBIT 3: SUMMARY OF RESISTANCE FACTORS

ESU	Resistance Limit	Resistance Factor
ESUs 1, 2C, 4A, and Common Borrow Fill	Strength Limit	0.45
	Extreme Event Limit	0.9

EXHIBIT 4: SUMMARY OF BEARING RESISTANCES FOR VARIOUS FOOTING WIDTHS

	Nominal Resistance (psf[1])	
Footing Width (feet)	*In Situ* Soils (ESUs 1, 2C, and 4A)	Common Borrow
2	14,400	9,200
3	17,400	11,000
4	20,400	12,800
5	23,200	14,600
6	26,200	16,400
7	29,100	18,100
8	32,000	19,900
9	34,900	21,600
10	37,700	23,300

Notes:
1 psf = pounds per square foot

EXHIBIT 5: SERVICE LIMIT STATE FOR 1-INCH CRITERIA

	Bearing Resistance (psf), 1-inch Service Limit State	
Footing Width (feet)	*In Situ* Soils (ESUs 1, 2C, and 4A)	Common Borrow
2	10,500	10,500
3	7,700	7,700
4	6,200	6,200
5	5,300	5,300
6	4,600	4,600
7	4,200	4,200
8	3,800	3,800
9	3,500	3,500
10	3,300	3,300

Moment Slab Foundation Bearing

Based on review of the existing geotechnical information, the proposed moment slabs will bear in either ESU 1 (fill), ESU 2C, or new Common Borrow. In general, ESU 1, ESU 2C, and Common Borrow are suitable to support the moment slabs; however, variability in fill material and density may affect suitability. When encountered, the existing fill should be assessed by a geotechnical engineer to determine its suitability as foundation subgrade and if any over-excavation is necessary.

Moment slab bearing elevations assumed for our recommendations are based on the plan sheets titled “Bridge Approach Walls with Moment Slab” prepared by WSDOT dated August 3, 2021 (included as Attachment B), as well as communications with the project team. The footing elevations of the moment slabs range along different bridges from 2200 feet to 2657 feet.

Exhibit 6 summarizes the moment slab extents at each bridge location, the length of moment slabs bearing on grade and/or retaining wall, and the ESU on which the slabs are expected to bear. Exhibit 3, earlier in this memorandum, summarizes our recommended resistance factors for all soil units. Our recommended nominal and 1-inch Service Limit State bearing resistances are presented in Exhibits 7 and 8, respectively, for a footing width of 11.5 feet and lengths ranging from 30 to 70 feet.

EXHIBIT 6: SUMMARY OF MOMENT SLAB LOCATIONS

Structure	Pier	End of Moment Slab Stations		Approximate Moment Slab Length on Grade (feet)		Approximate Moment Slab Length on Wall (feet)[1]		Bearing soil	
		Left	Right	Left	Right	Left	Right	Left	Right
Cedar Creek WB	1	N/A	1700+91		19		11	N/A	ESU 2C
Cedar Creek WB	2	N/A	1702+54		17		13	N/A	ESU 2C
Telephone Creek	1	N/A	1749+82		6		30	N/A	N/A
Telephone Creek	2	N/A	1751+62		5		50	N/A	Common Borrow
Hudson Creek WB	1	1801+38.67	1801+39	5	4	25	26	N/A	ESU 1
Hudson Creek WB	2	1803+85.00	1804+00	9	4	37	57	N/A	N/A
Hudson Creek EB	1	N/A	1800+66		14		16	N/A	Common Borrow
Hudson Creek EB	2	1803+33.00	N/A	4		27		N/A	N/A
Unnamed Creek MP 67.1 WB	1	N/A	1829+29		16		14	N/A	Common Borrow
Unnamed Creek MP 67.1 WB	4	N/A	1833+45		16		14	N/A	Common Borrow
Wildlife Undercrossing WB	1	1916+20.00	N/A	5		34		N/A	N/A
Sparks Road WB	1	1930+87.00	N/A	7		29		Common Borrow	N/A

Sparks Road EB	1	N/A	1930+48	5	36	N/A	N/A
Sparks Road EB	2	N/A	1932+30	7	23	N/A	Common Borrow

Notes:
1 At face of retaining wall only

EXHIBIT 7: SUMMARY OF BEARING RESISTANCES FOR VARIOUS MOMENT SLAB LENGTHS

Footing Width (feet)	Footing Length (feet)	Nominal Resistance (psf)	
		In Situ Soils (ESU 1, 2C)	Common Borrow
11.5	30	23,500	35,600
11.5	40	24,000	36,300
11.5	50	24,200	36,700
11.5	60	24,400	37,000
11.5	70	24,500	37,200

EXHIBIT 8: SERVICE LIMIT STATE FOR 1-INCH CRITERIA FOR MOMENT SLAB

Footing Width (feet)	Footing Length (feet)	Bearing Resistance (psf), 1-inch Service Limit State	
		In Situ Soils (ESU 1, 2C)	Common Borrow
11.5	30	3,000	4,000
11.5	40	2,800	3,700
11.5	50	2,700	3,500
11.5	60	2,700	3,400
11.5	70	2,600	3,400

According to the moment slabs geometry from plan sheets titled “Bridge Approach Walls with Moment Slab” prepared by WSDOT (Attachment B), as well as communications with the project team, we understand portions of the moment slabs will bear on grade, and the other parts will bear immediately adjacent to proposed retaining walls. In this case, the lateral earth pressure on the retaining wall due to pressure from the moment slab footing needs to be considered when designing the retaining wall. We recommend calculating the earth pressures on the retaining wall following recommendations in Section 3.11.6.2 of AASHTO LRFD. Note, the strength limit state bearing resistances based on Exhibit 7, above, may need to be limited to the allowable pressure the retaining wall can structurally support.

Coefficient of Subgrade Reaction

Given the uncertainty associated with the near-surface soil conditions, we recommend checking the moment slab bearing design for an upper and lower bound coefficient of subgrade reaction of 20 and 100 pounds per cubic inch (assuming Common Borrow fill subgrade). We determined this range based on the proposed dimensions of the moment slabs, the estimated elastic modulus of the Common Borrow material (see next section), and our experience in similar materials. If the final design is found to be sensitive within this range, the Geotechnical Office should be contacted to refine this recommendation.

Elastic Parameters for Bearing Material

The T-3 AASHTO Guide Specifications for LRFD Seismic Bridge Design references the Seismic Rehabilitation of Existing Buildings, ASCE/SEI 31-06, as a document that can be used by the structural designer to develop the soil springs for foundation modeling. The Bridge and Structures Office has adopted these procedures for the development of soil springs. Evaluating shallow foundation springs requires values for the dynamic shear modulus, *G*, Poisson's ratio, and the unit weight of the foundation soils. Exhibit 6 provides design parameters for developing the soil springs.

EXHIBIT 9: ELASTIC PARAMETERS FOR BEARING MATERIAL

ESU	Young's Modulus (ksf[1]), E_s	G_0 (ksf)	G/G_0	Shear Wave Velocity (feet/second)	Poisson's Ratio	Soil Unit Weight (pcf[2])
ESU 1/2C/4A	700	1,900	0.61	700	0.25	120
Common Borrow Fill	700	2,100	0.61	750	0.35	120

Notes:
1 ksf – kips per square foot
2 pcf = pounds per cubic foot

Foundation Loading on Drainage Pipe

We understand that an 18-inch drainage line is proposed within the zone of influence of the differential barrier footing. The stress influence on the 18-inch pipe was calculated based on the footing geometry and service loading and the pipe geometry provided to us by the structural engineer. Exhibit 10 presents the stress influence on the proposed drainage pipe from the footing load in terms of an equivalent fill height. The equivalent fill height is based on a soil unit weight of 120 pcf. The drainage designer should consider the actual pipe embedment, plus the values from Exhibit 7 when determining the appropriate material for the pipe.

EXHIBIT 10: FOUNDATION LOADING ON DRAINAGE PIPE

LE Station	Vertical Distance from Top of Pipe to Bottom of Footing (feet)	Horizontal Distance from Pipe to Toe of Footing (feet)	Effective Footing Width (feet)	Bearing, Service Case (ksf)	Stress Influence Factor	Equivalent Fill Height (feet)
1775+34	1.28	2.15	7.50	1.96	0.031	1
1776+37	1.94	0.60	7.49	1.96	0.310	5
1777+39	3.08	1.59	7.50	1.95	0.211	3
1778+41	4.58	1.96	7.52	1.94	0.237	4
1779+43	7.35	2.68	6.87	1.88	0.231	4
1780+42	9.96	5.89	6.94	1.94	0.135	2
1781+42	12.04	7.01	5.71	1.81	0.111	2
1782+42	13.98	9.02	4.78	1.79	0.080	1
1783+42	16.09	11.04	4.76	1.77	0.066	1
1784+42	18.27	13.06	4.77	1.78	0.057	1
1785+34	20.73	14.91	4.85	1.98	0.052	1

We understand portions of the proposed drainage line will be in areas with minimal cover based on the final grading plans. In areas of minimal cover (i.e. less than 2 feet bgs) we recommend backfilling with controlled density fill (CDF) above the drain line bedding section. Additionally, we recommend including a separation geotextile generally conforming to WSDOT Standard Specifications Table 3 in Section 9-33.2(1) for separation.

Lateral Earth Pressure

Soil parameters for design of the grade barrier and moment slab structures are provided in Exhibit 11, and assume the backfill of the grade barrier structures consists of Common Borrow. Backfill material must be placed in accordance with Method B, WSDOT Standard Specification 2-03.3 (14)C. Lateral earth pressure parameters for other materials can be provided upon request.

EXHIBIT 11: NOMINAL LATERAL EARTH PRESSURE PARAMETERS (COMMON BORROW)

Parameter	Value
Soil Friction Angle (degrees)	32
Soil Unit Weight (pcf)	120
Active Earth Pressure Coefficient (k_a)	0.28
At-rest Earth Pressure Coefficient (k_o)	0.47
Passive Earth Pressure Coefficient (k_p)	7.22
Seismic Active Earth Pressure Coefficient (k_{ae})	0.39
Seismic Passive Earth Pressure Coefficient (k_{pe})	6.19

Lateral Resistance to Sliding

Lateral forces on spread footings will be resisted, in part, by frictional sliding resistance at the base of the footing and passive earth resistance on the edge of the footing. The contributions of both can be added together to provide the total resistance to sliding. It is our understanding that frictional sliding resistance will be determined using AASHTO LRFD Section 10.6.3.4. The friction angles described in Exhibit 12 may be used for sliding resistance. A sliding resistance factor of 0.9 should be used for precast concrete footings and a sliding resistance factor of 0.8 should be used for cast-in-place footings.

EXHIBIT 12: SLIDING RESISTANCE PARAMETERS

ESU	Soil Friction Angle, ϕ (degrees)	Tan (ϕ)
In-situ Soils (1, 2C, 4A)	35	0.7
Common Borrow Fill	32	0.6

Sliding resistance of footings may be resisted, in part, by passive earth resistance, as described in the following section. For passive resistance, a resistance factor of 0.5 should be applied. Ignore the upper 2 feet of passive resistance unless the ground surface in front of the element being considered is paved.

Passive resistance should be ignored if drainage structures or other utilities are buried in front of the retaining barriers.

Drainage

In order to prevent the build up of water pressure behind the grade barrier, a free draining material should be used directly behind the wall in accordance with Standard Plan D-4. The material should be free draining, with no more than 5 percent fines and should meet the specifications of WSS 9-03.12(2) – Gravel Backfill for Walls.

Weepholes or drainlines should be installed to allow water to escape from behind the wall. Hydrostatic pressures should be used below the weephole or drainline elevations.

Slope Stability

We assessed the global stability of the grade barrier at its tallest point, approximately 8 feet of retained soil at station 1775+00. We used the program Slide2 (Rocscience 2019) and modeled the concrete barrier under both static and pseudostatic conditions. The results of our analyses confirm that the barrier walls meet global stability design requirements, as presented in Exhibit 13.

EXHIBIT 13: GLOBAL STABILITY FACTORS OF SAFETY

Scenario	Factor of Safety	Minimum Factor of Safety required by WSDOT
Static	2.5	1.3
Pseudostatic	1.5	1.1

CONSTRUCTION CONSIDERATIONS

In areas where loose soil is encountered beneath proposed barrier footings, it must be over-excavated to more competent material. For planning purposes, we recommend assuming that over-excavations of up to 3 feet of the footing subgrade may be required along approximately half of the grade barrier alignment. The overexcavation should extend laterally a minimum of 1 foot outside the footing perimeter. Increase this excavation distance laterally around the perimeter equal to the depth of the over-excavation (i.e. at a 1H:1V projection).

Groundwater may be encountered during excavation, depending on time of year and precipitation. We recommend excavation take place during the drier late summer and early fall months.

Cobbles and boulders may be present within ESUs 1, 2C, and 4A. Such large materials could make drilling and/or excavation difficult. Therefore, the contractor should be prepared to deal with large obstructions. In addition, the site soils may also contain relatively clean sand and/or gravel zones, where groundwater may accumulate and be more prone to caving when exposed in a vertical face or encountered in a drilled hole. Contract documents should require the contractor to be prepared to encounter these conditions.

Temporary Excavations

We understand the contractor will be responsible for maintaining the work zone and any excavations for temporary (short-term) stability. The safety of temporary slopes is the contractor's responsibility, as it is the contractor that will be onsite full-time and in control of the site. The contractor will also be responsible for temporary shoring (if necessary), and any required dewatering for groundwater or surface water needed to complete the work. In general, drainage trenches and ditches, as described in WSDOT GDM Section 10.3.3 (WSDOT 2019), should be implemented.

Excavations should be made in accordance with all local, state, and federal safety requirements. For planning purposes, the soils across the site are expected to be Occupational Safety and Health Administration Soil Classification Type C.

The stability and safety of open trenches and cut slopes depend on a number of factors, including:

- Type and density of the soil;
- Presence and amount of any seepage;
- Depth of cut;

- Proximity of the cut to any surcharge loads near the top of the cut, such as stockpiled material, traffic loads, or structures;
- Duration of the open excavation; and
- Care and methods used by the contractor.

Based on these factors, we recommend:

- Using plastic sheeting to protect slopes from erosion; and
- Limiting the duration of open excavations as much as possible.

RECOMMENDED ADDITIONAL GEOTECHNICAL SERVICES

During the construction phase of the project, we recommend that HQ Geotechnical Office representative(s), in conjunction with the Regional Materials Engineer, provide the following post-report additional services:

- Review the final design plans and specifications to verify that the geotechnical engineering recommendations have been properly interpreted and implemented into the design;
- Attend pre-construction meetings with the Construction Project Engineer and Contractor to review construction-related issues;
- Review Contractor submittals for grade barriers, fill material, temporary slopes, and any other geotechnical elements of the Project; and
- Observe the geotechnical aspects of construction in the field. This includes, but is not limited to, footing and fill subgrades, drainage, and fill placement and compaction.

The purpose of these observations and services is to note compliance with the design concepts, specifications, or recommendations, and to allow design changes or evaluation of appropriate construction measures in the event that subsurface conditions differ from those anticipated prior to the start of construction.

USE OF THIS MEMORANDUM

This report is for the exclusive use of WSDOT and their design consultants and contractors for specific application to the subject project and site. We completed this work in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. We make no other warranty, express or implied.

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Senior Foundation Engineer
Geotechnical Office

Agency Approval Authority: Andrew Fiske, P.E.
State Geotechnical Engineer

REFERENCES

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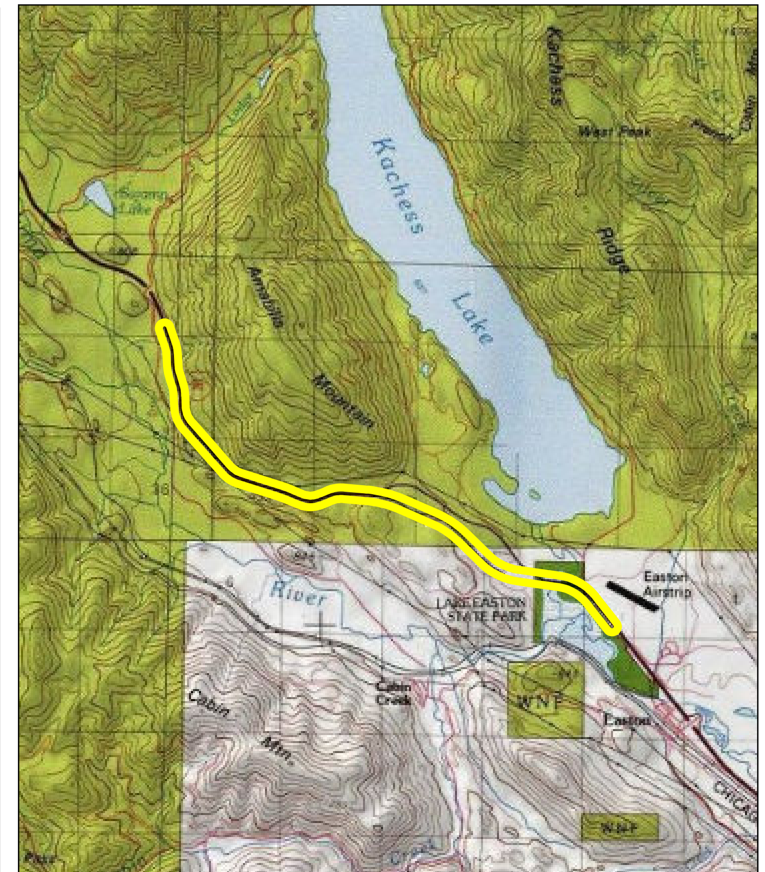
JJW:RBH:DTM:TMA/lda:lik:snb

Attachments:
- Figure 1 – Site Vicinity Map
- Attachment A – Differential Barrier – Plan and Profile Sheets
- Attachment B – Bridge Approach Walls with Moment Slab



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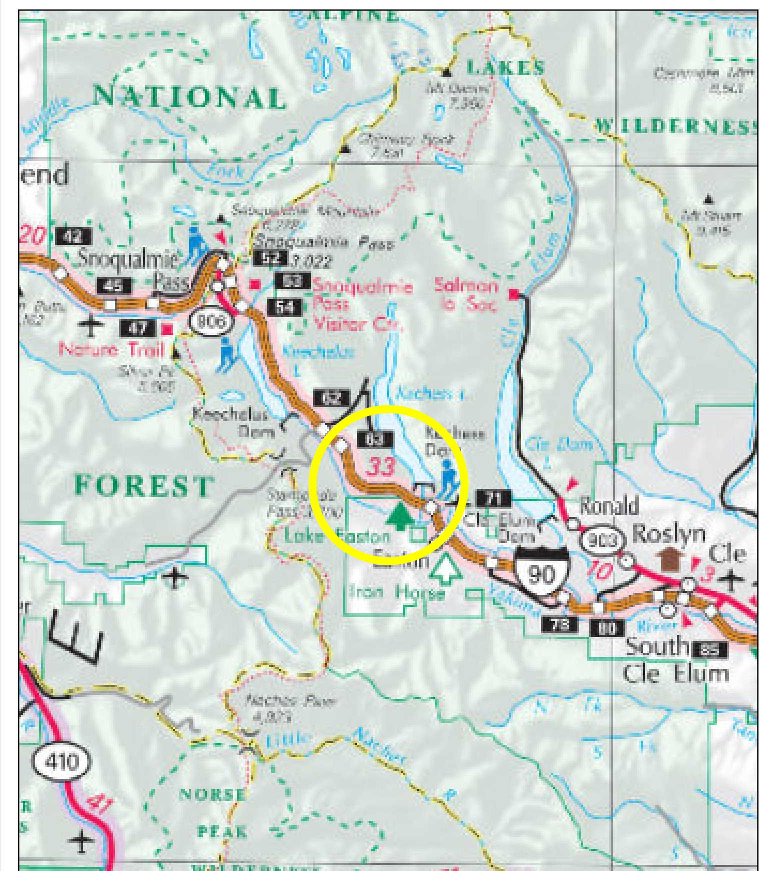

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MILES
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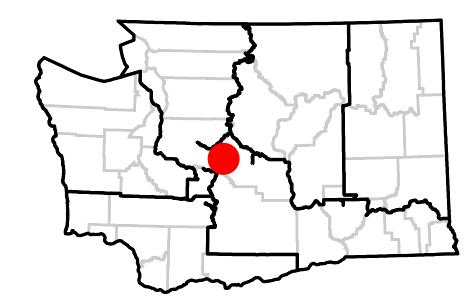
Legend

- Milepost Markers
- Phase 3 Project Vicinity
- U.S. Interstate
- WSDOT Regions
- County Boundaries (1:500K)
- Grade Separation Barrier Vicinity

N



JOB # XL5479 **STATE ROUTE** 090 **MILEPOST(S)** 64.40 to 70.30

FIGURE 1: SITE VICINITY MAP

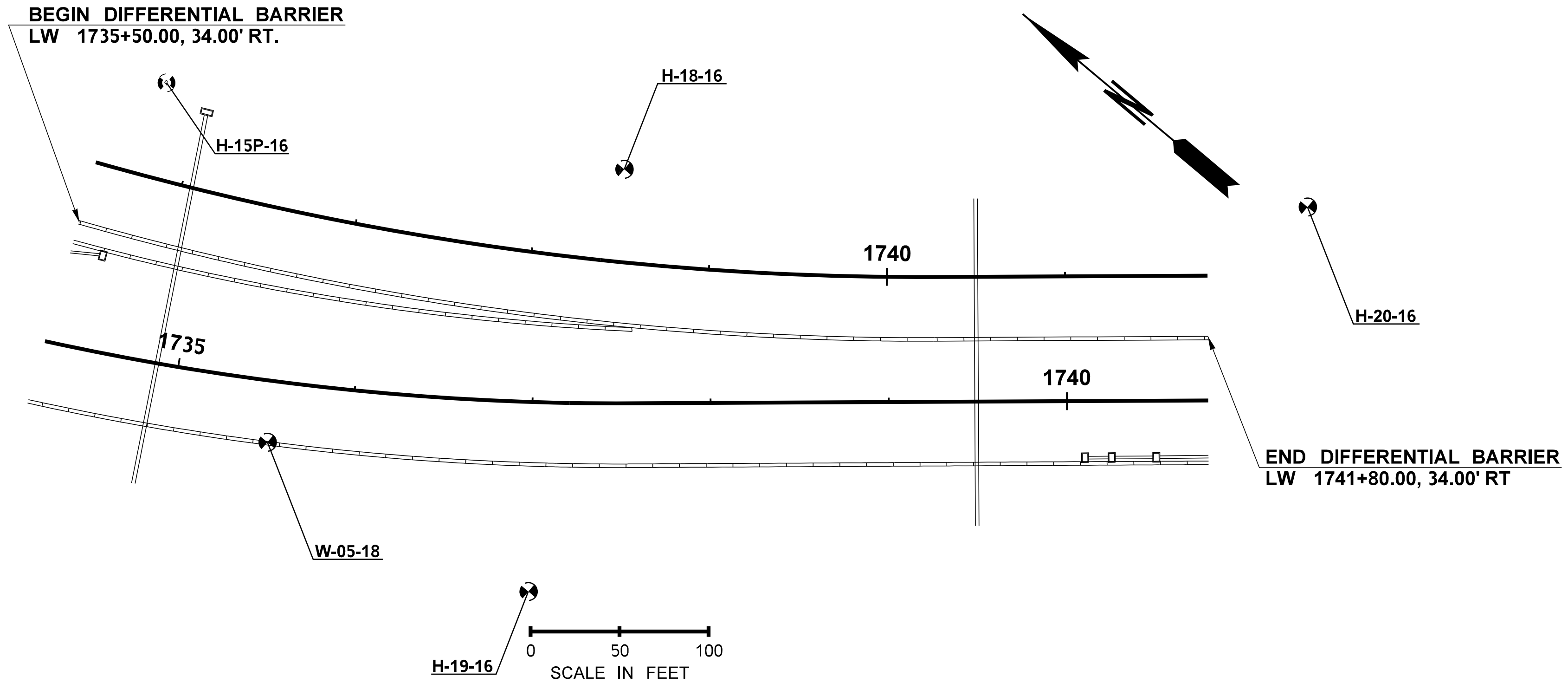
I-90 / Cabin Creek I/C to W. Easton I/C
Phase 3 - Add Lanes/Build Wildlife Bridges

WSDOT GEOTECHNICAL OFFICE

PREPARED BY TropleT Date: August 5, 2020

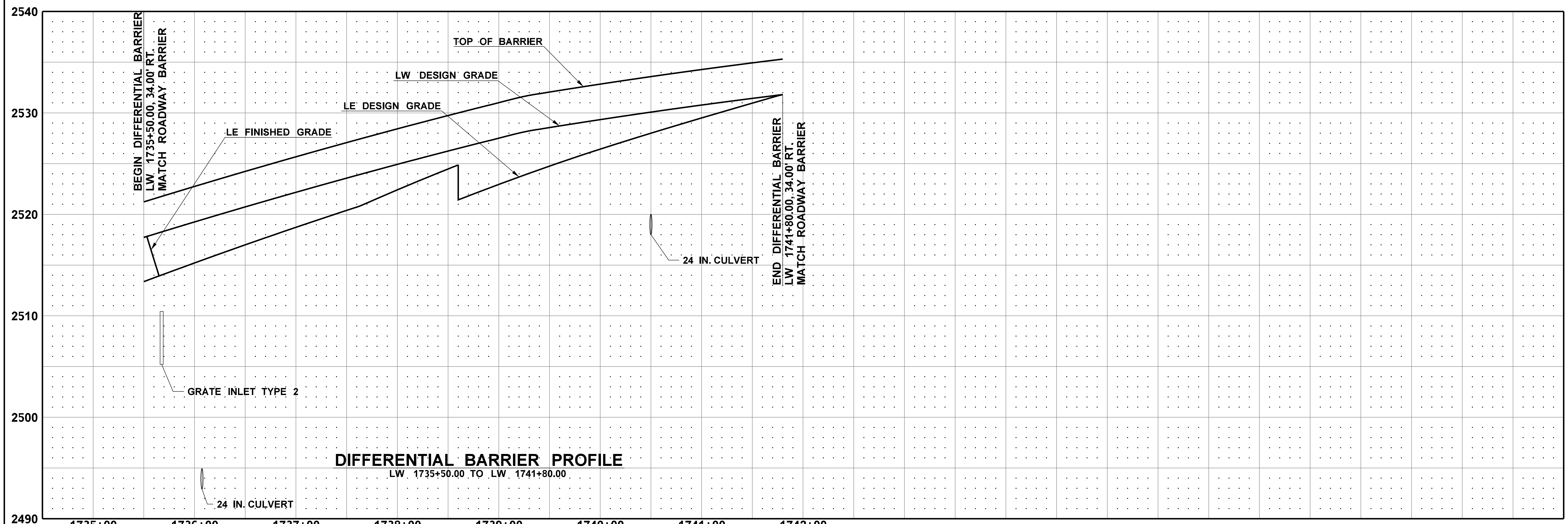
File Location: \\wsdot.loc\ml\Group\Geotechnical\GEOGIS\Projects\SR-090\SR90-XL5479-GT-EastonHilltoWEastonIC\Projects\Phase3\ArcProProject\SR090-XL5479-GT-SnoqualmiePassPhase3.aprx

ATTACHMENT A: DIFFERENTIAL BARRIER – PLAN AND PROFILE SHEETS



NOTES:

1. DESIGN OF PIPES THAT OUT FALL THROUGH WALL 1 & 2 ARE STILL IN PROGRESS. ELEVATIONS ARE LIKELY TO CHANGE. STATIONS ANTICIPATED TO CHANGE BY +/- 5'.
2. UNDERDRAINS HAVE NOT BEEN DESIGNED AND ARE NOT SHOWN.
3. FINISHED GRADE MATCHES DESIGN GRADE EXCEPT WHERE SHOWN OTHERWISE.
4. OFFSETS ARE TO THE LW FACE OF BARRIER AT THE CURB LINE.



DIFFERENTIAL BARRIER PROFILE

LW 1735+50.00 TO LW 1741+80.00

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DESIGNED BY	M. GIPNER				
ENTERED BY	M. GIPNER				
CHECKED BY	K. KING				
PROJ. ENGR.	A. BYRD				
REGIONAL ADM.	T. TREPANIER	REVISION	DATE	BY	

REGION NO. 10 | STATE WASH | FED.AID PROJ.NO.

JOB NUMBER

CONTRACT NO. | LOCATION NO.

DATE
P.E. STAMP BOX

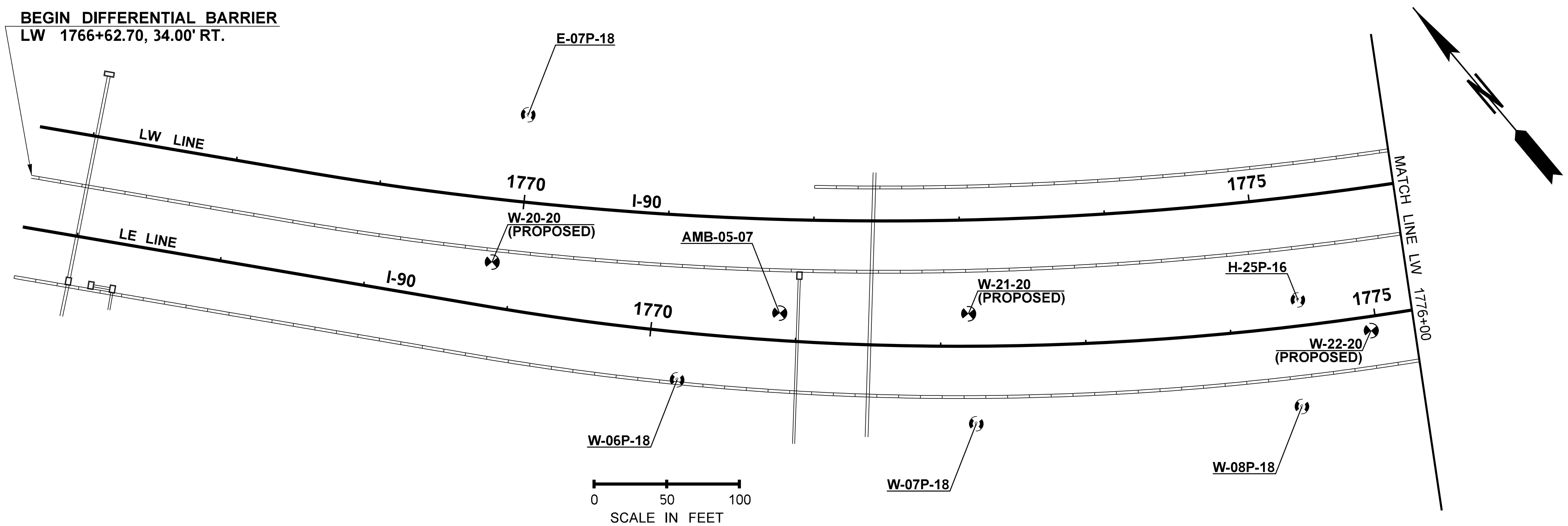
DATE
P.E. STAMP BOX

Washington State Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

DIFFERENTIAL BARRIER - PLAN AND PROFILE

Plot 1
PLAN REF. NO.
DB1
SHEET
OF
SHEETS



NOTES:

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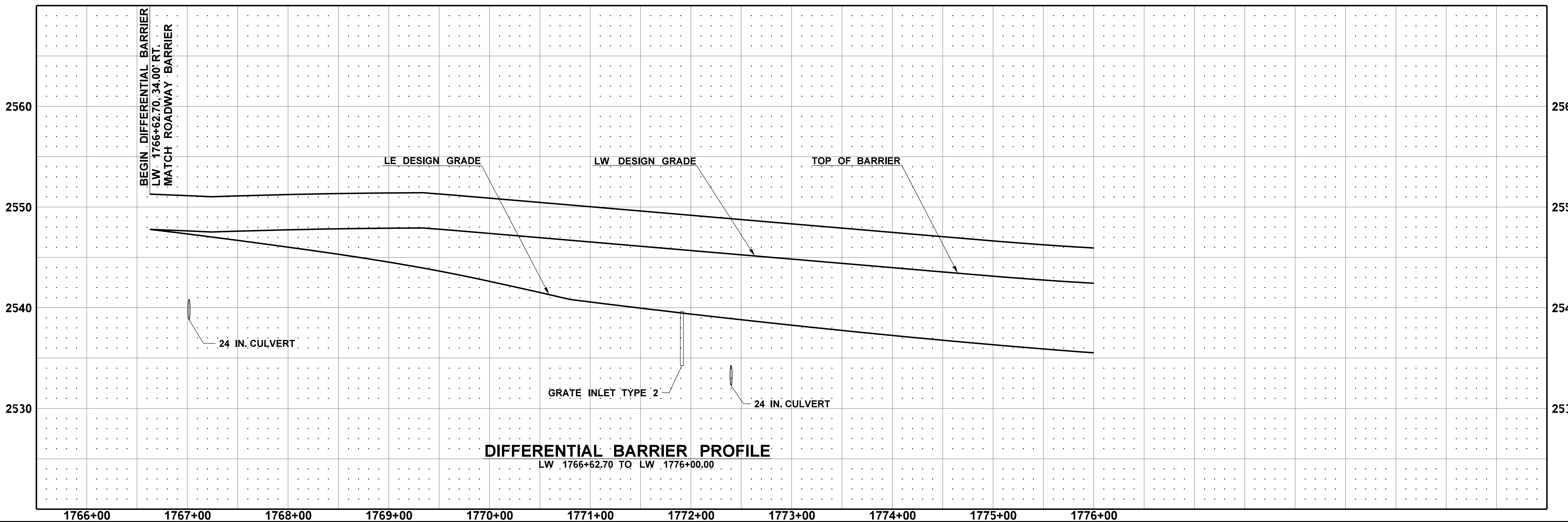
4. OFFSETS ARE TO THE LW FACE OF BARRIER AT THE CURB LINE.



DIFFERENTIAL BARRIER PROFILE

LW 1766+62.70 TO LW 1776+00.00

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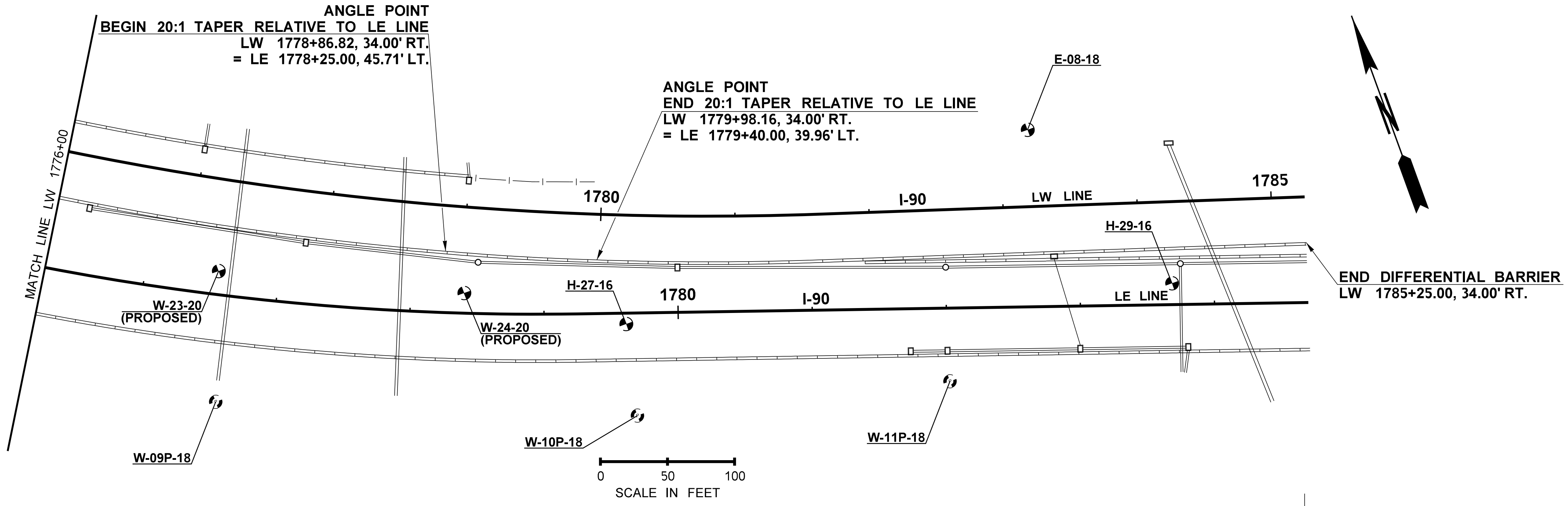
I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

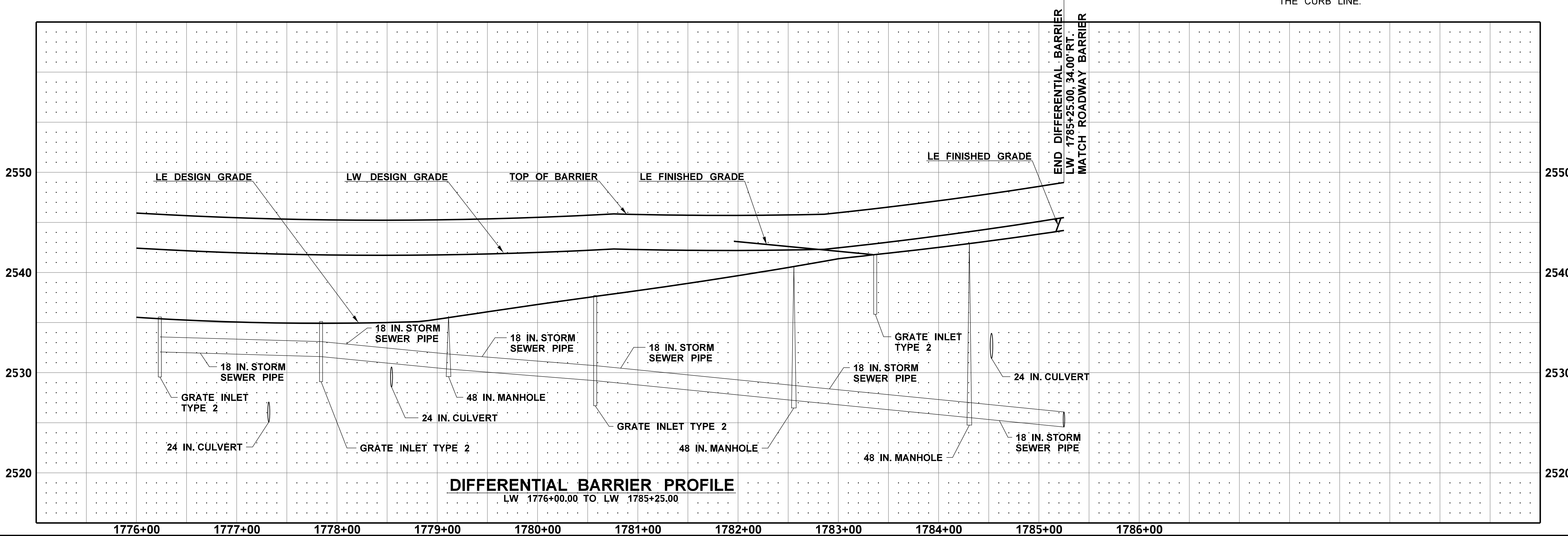
DIFFERENTIAL BARRIER - PLAN AND PROFILE

Plot 2
PLAN REF. NO. DB2
SHEET OF SHEETS



NOTES:

1. DESIGN OF PIPES THAT OUT FALL THROUGH WALL 1 & 2 ARE STILL IN PROGRESS. ELEVATIONS ARE LIKELY TO CHANGE. STATIONS ANTICIPATED TO CHANGE BY +/- 5'.
2. UNDERDRAINS HAVE NOT BEEN DESIGNED AND ARE NOT SHOWN.
3. FINISHED GRADE MATCHES DESIGN GRADE EXCEPT WHERE SHOWN OTHERWISE.
4. OFFSETS ARE TO THE LW FACE OF BARRIER AT THE CURB LINE.



DIFFERENTIAL BARRIER PROFILE
LW 1776+00.00 TO LW 1785+25.00

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PROJ. ENGR.	A. BYRD			
REGIONAL ADM.	T. TREPANIER	REVISION	DATE	BY

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CONTRACT NO.	LOCATION NO.	

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Washington State Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

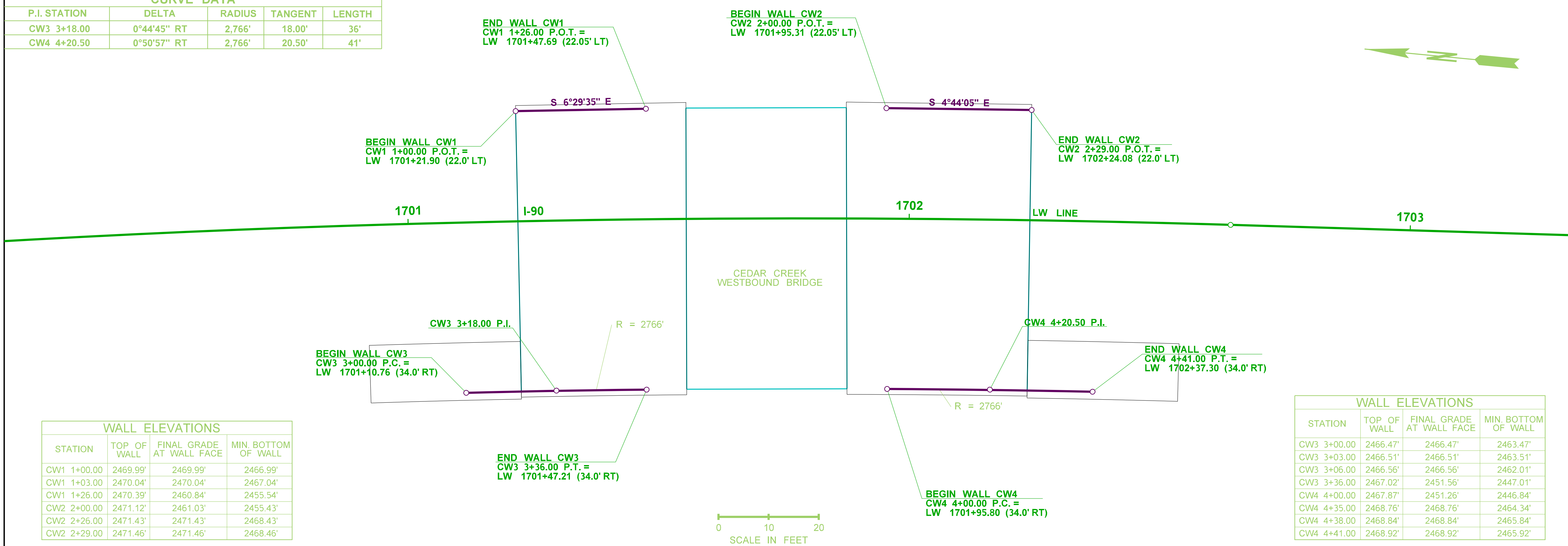
DIFFERENTIAL BARRIER - PLAN AND PROFILE

Plot 3
PLAN REF. NO. DB3
SHEET OF SHEETS

ATTACHMENT B: BRIDGE APPROACH WALLS WITH MOMENT SLAB

CURVE DATA

P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH
CW3 3+18.00	0°44'45" RT	2,766'	18.00'	36'
CW4 4+20.50	0°50'57" RT	2,766'	20.50'	41'

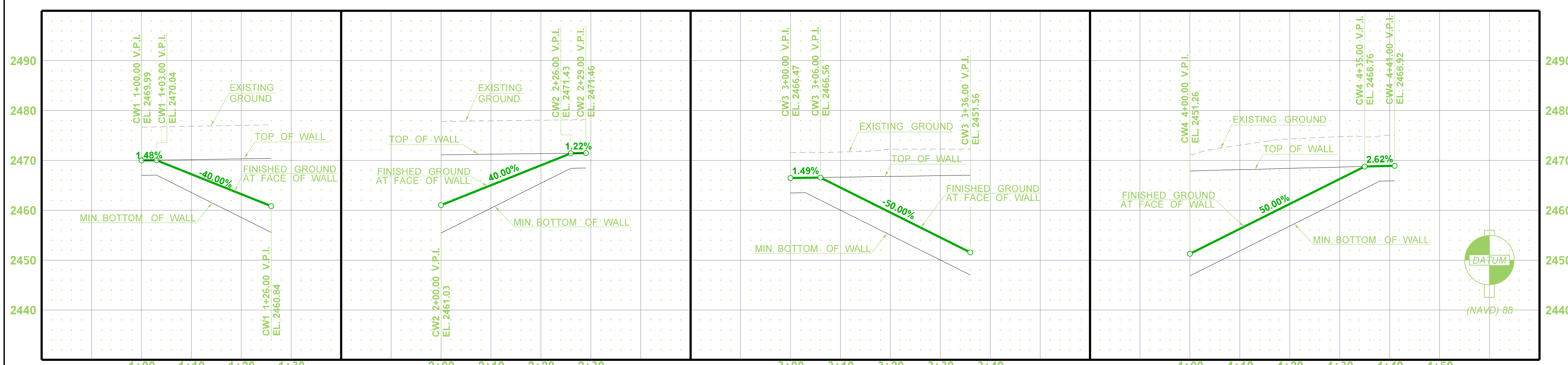


WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
CW1 1+00.00	2469.99'	2469.99'	2466.99'
CW1 1+03.00	2470.04'	2470.04'	2467.04'
CW1 1+26.00	2470.39'	2460.84'	2455.54'
CW2 2+00.00	2471.12'	2461.03'	2455.43'
CW2 2+26.00	2471.43'	2471.43'	2468.43'
CW2 2+29.00	2471.46'	2471.46'	2468.46'

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
CW3 3+00.00	2466.47'	2466.47'	2463.47'
CW3 3+03.00	2466.51'	2466.51'	2463.51'
CW3 3+06.00	2466.56'	2466.56'	2462.01'
CW3 3+36.00	2467.02'	2451.56'	2447.01'
CW4 4+00.00	2467.87'	2451.26'	2446.84'
CW4 4+35.00	2468.76'	2468.76'	2464.34'
CW4 4+38.00	2468.84'	2468.84'	2465.84'
CW4 4+41.00	2468.92'	2468.92'	2465.92'



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DESIGNED BY	M. GIPNER / K. KING
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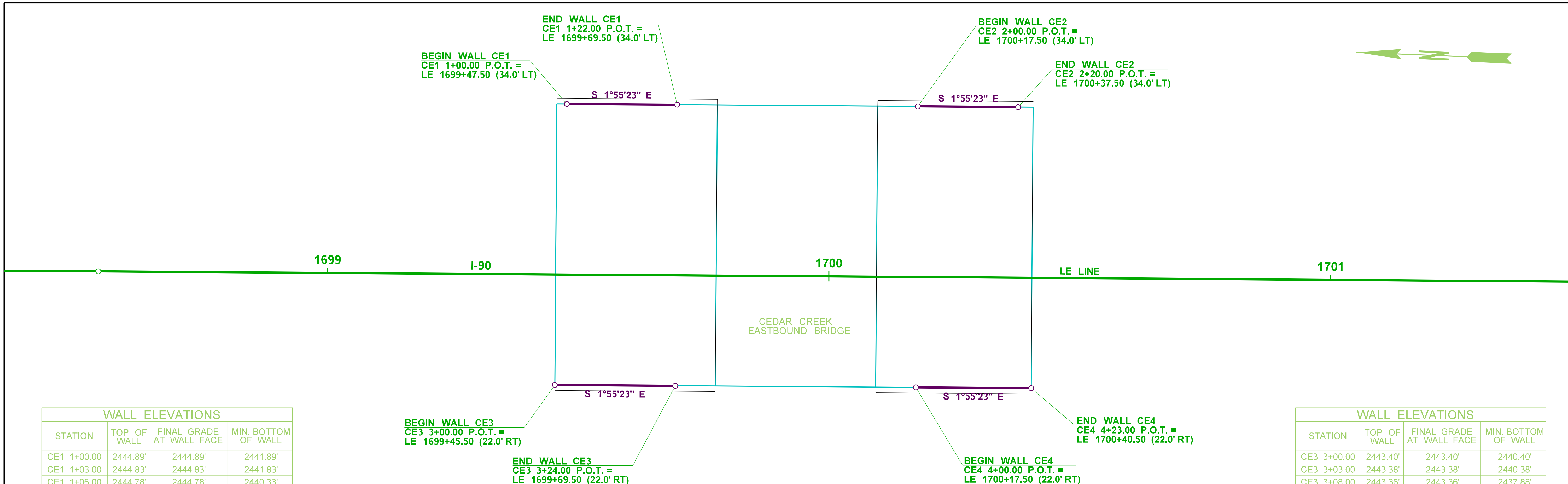
Washington State
Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES
CEDAR CRK WALL PLAN AND PROFILE

Plot 1
PLAN REF NO
WS1
SHEET
OF
SHEETS

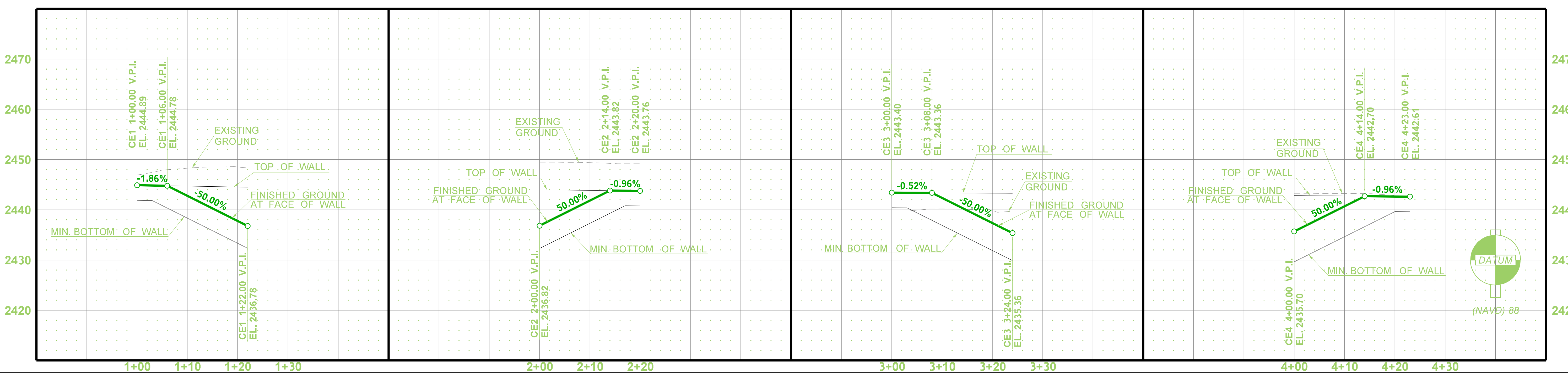


WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
CE1 1+00.00	2444.89'	2444.89'	2441.89'
CE1 1+03.00	2444.83'	2444.83'	2441.83'
CE1 1+06.00	2444.78'	2444.78'	2440.33'
CE1 1+22.00	2444.48'	2436.78'	2432.33'
CE2 2+00.00	2443.95'	2436.82'	2432.29'
CE2 2+14.00	2443.82'	2443.82'	2439.29'
CE2 2+17.00	2443.79'	2443.79'	2440.79'
CE2 2+20.00	2443.76'	2443.76'	2440.76'

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
CE3 3+00.00	2443.40'	2443.40'	2440.40'
CE3 3+03.00	2443.38'	2443.38'	2440.38'
CE3 3+08.00	2443.36'	2443.36'	2437.88'
CE3 3+24.00	2443.28'	2435.36'	2429.88'
CE4 4+00.00	2442.83'	2435.70'	2429.64'
CE4 4+14.00	2442.70'	2442.70'	2436.64'
CE4 4+20.00	2442.64'	2442.64'	2439.64'
CE4 4+23.00	2442.61	2442.61'	2439.61'



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DESIGNED BY	M. GIPNER / K. KING
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PROJ. ENGR.	A. BYRD
REGIONAL ADM.	T. TREPANIER

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Washington State Department of Transportation

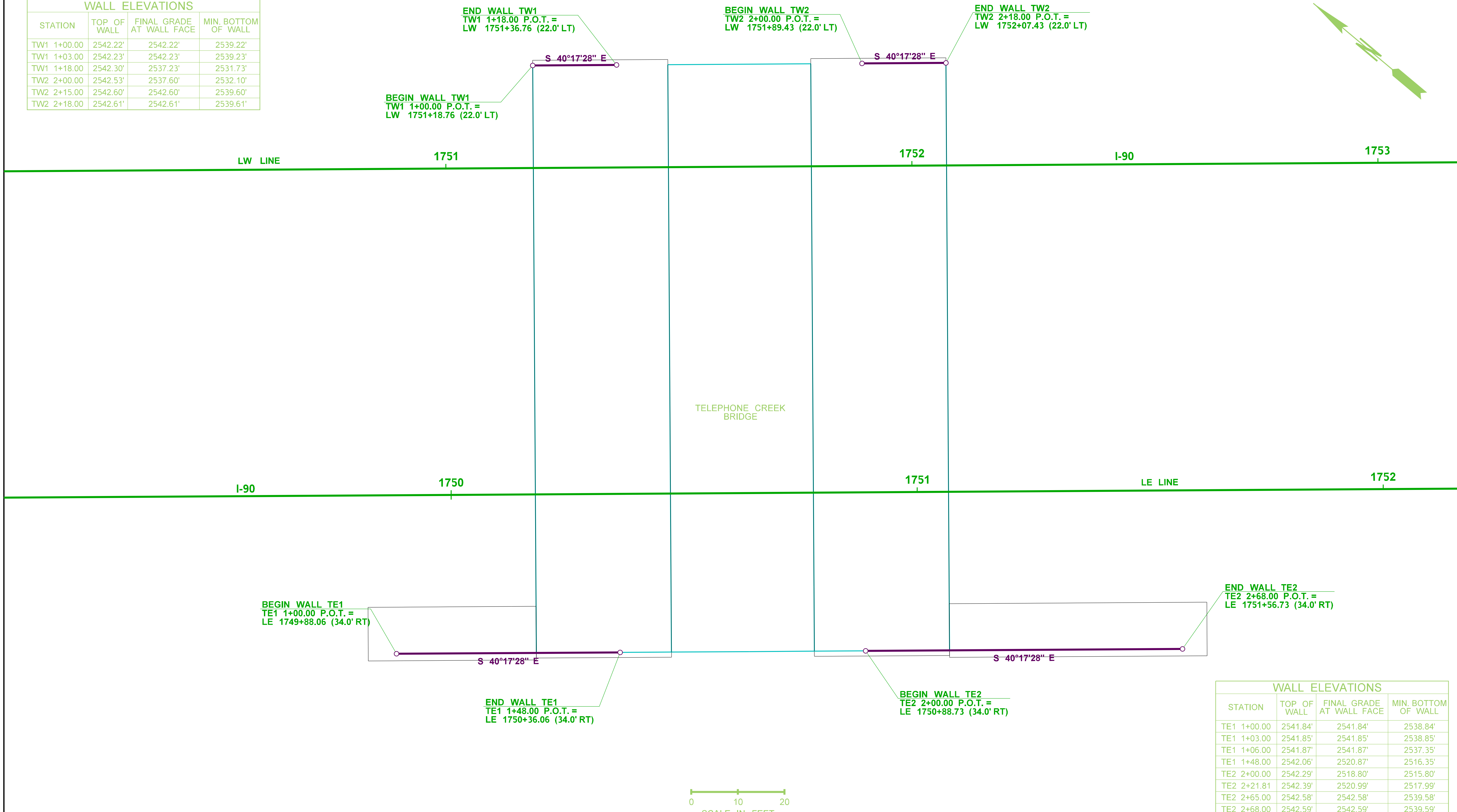
I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

CEDAR CRK WALL PLAN AND PROFILE

Plot 2
PLAN REF NO
WS2
SHEET
OF
SHEETS

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
TW1 1+00.00	2542.22'	2542.22'	2539.22'
TW1 1+03.00	2542.23'	2542.23'	2539.23'
TW1 1+18.00	2542.30'	2537.23'	2531.73'
TW2 2+00.00	2542.53'	2537.60'	2532.10'
TW2 2+15.00	2542.60'	2542.60'	2539.60'
TW2 2+18.00	2542.61'	2542.61'	2539.61'



WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
TE1 1+00.00	2541.84'	2541.84'	2538.84'
TE1 1+03.00	2541.85'	2541.85'	2538.85'
TE1 1+06.00	2541.87'	2541.87'	2537.35'
TE1 1+48.00	2542.06'	2520.87'	2516.35'
TE2 2+00.00	2542.29'	2518.80'	2515.80'
TE2 2+21.81	2542.39'	2520.99'	2517.99'
TE2 2+65.00	2542.58'	2542.58'	2539.58'
TE2 2+68.00	2542.59'	2542.59'	2539.59'

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REGIONAL ADM.	T. TREPANIER

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10	WASH	

JOB NUMBER

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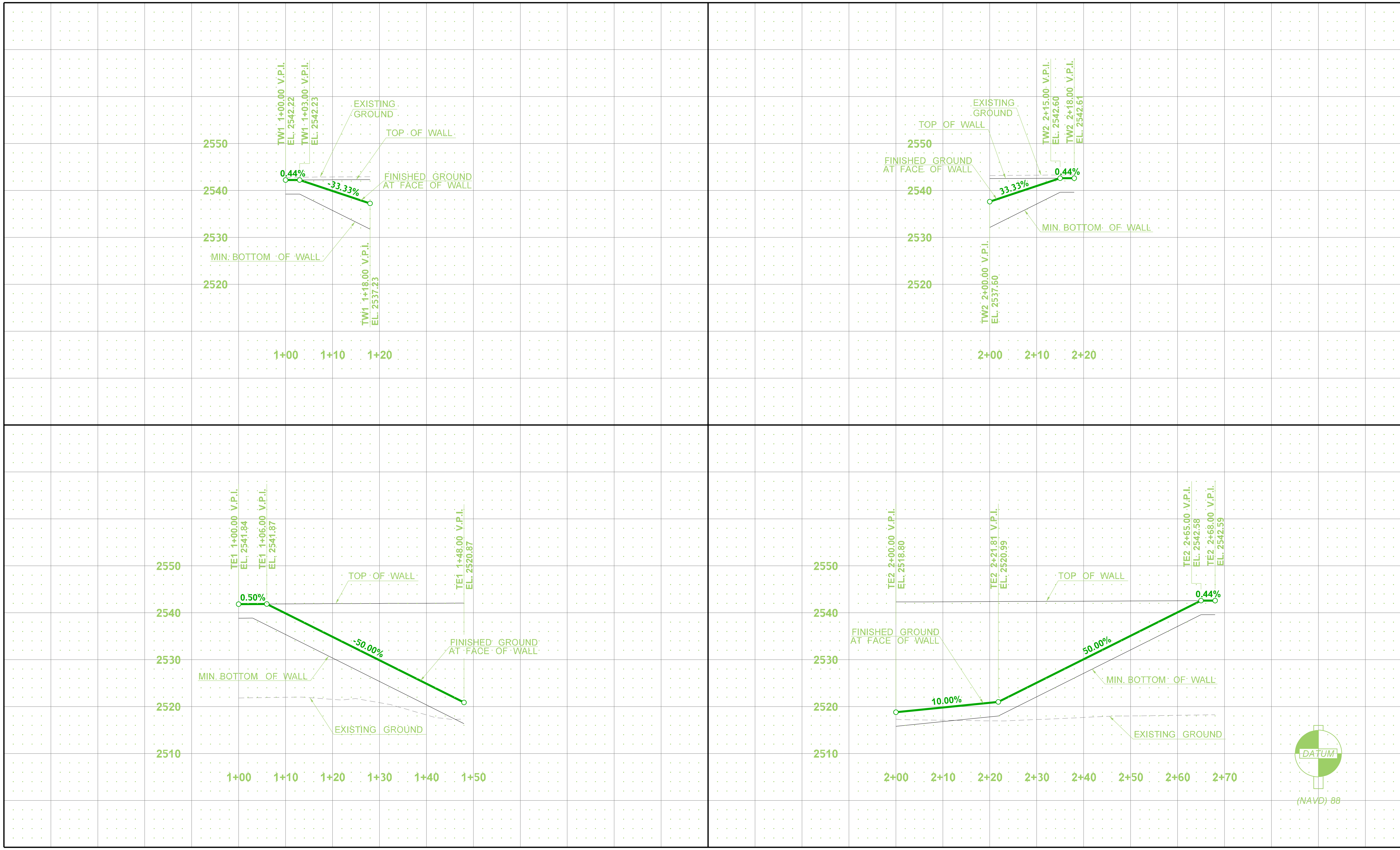
Washington State
Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES
TELEPHONE CRK WALL PLAN

Plot 3
PLAN REF NO
WS3
SHEET
OF
SHEETS



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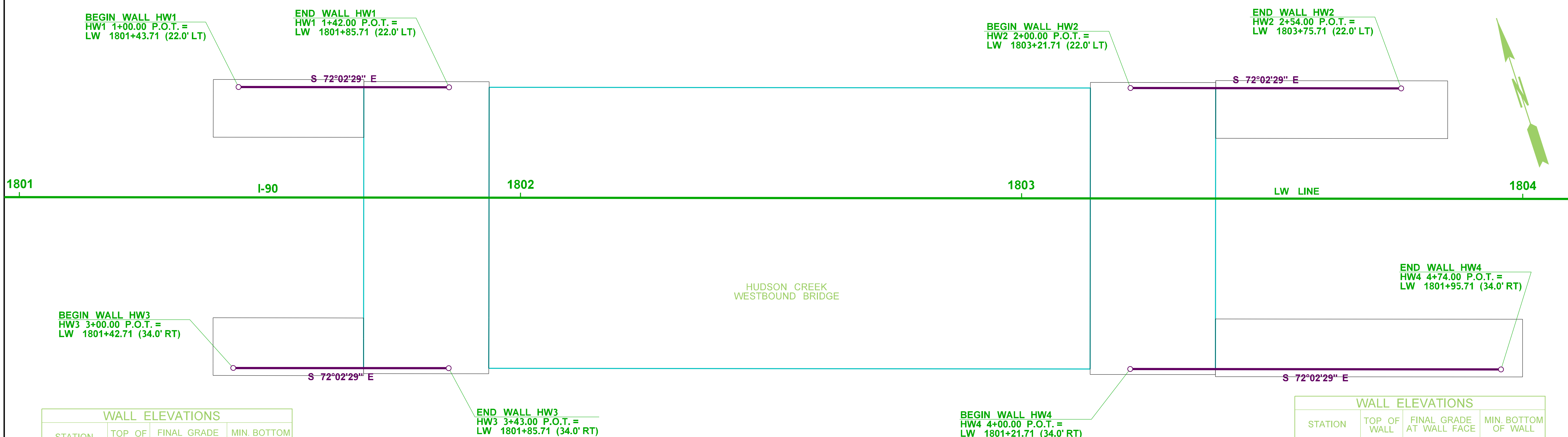
Washington State Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

TELEPHONE CRK
WALL PROFILE

Plot 4
PLAN REF. NO.
WS4
SHEET
OF
SHEETS



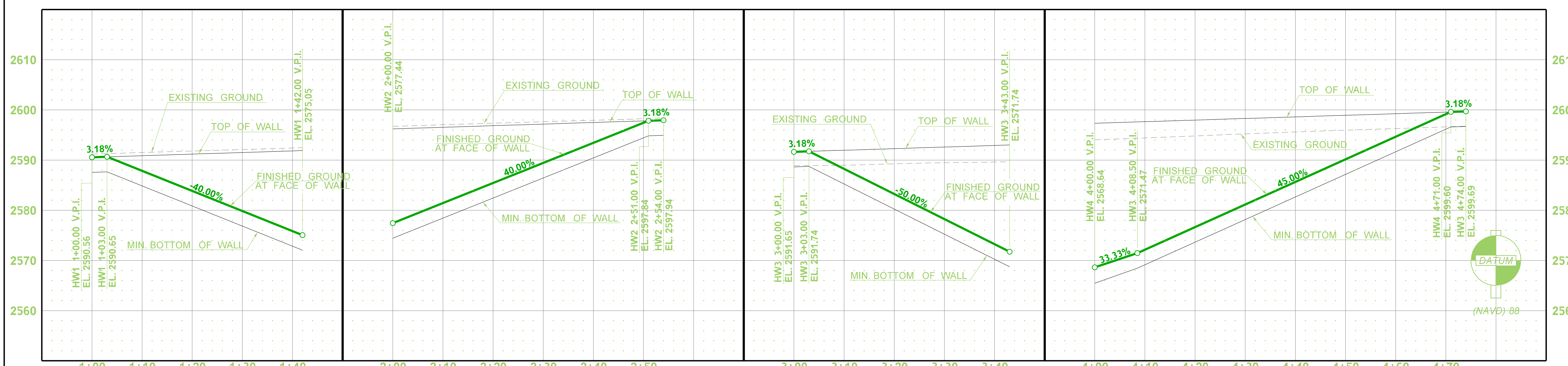
WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
HW1 1+00.00	2590.56'	2590.56'	2587.56'
HW1 1+03.00	2590.65'	2590.65'	2587.65'
HW1 1+42.00	2591.90'	2575.05'	2572.05'
HW2 2+00.00	2596.22'	2577.44'	2574.44'
HW2 2+50.00	2597.81'	2597.44'	2594.44'
HW2 2+51.00	2597.84'	2597.84'	2594.84'
HW2 2+54.00	2597.94'	2597.94'	2594.94'

0 10 20
SCALE IN FEET

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
HW3 3+00.00	2591.65'	2591.65'	2588.65'
HW3 3+03.00	2591.74'	2591.74'	2588.74'
HW3 3+43.00	2593.02'	2571.74'	2568.74'
HW4 4+00.00	2597.34'	2568.64'	2565.45'
HW4 4+08.50	2597.62'	2571.47'	2568.47'
HW4 4+50.00	2598.93'	2590.15'	2587.15'
HW4 4+71.00	2599.60	2599.60'	2596.60'
HW4 4+74.00	2599.69'	2599.69'	2596.69'



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10	WASH	

JOB NUMBER

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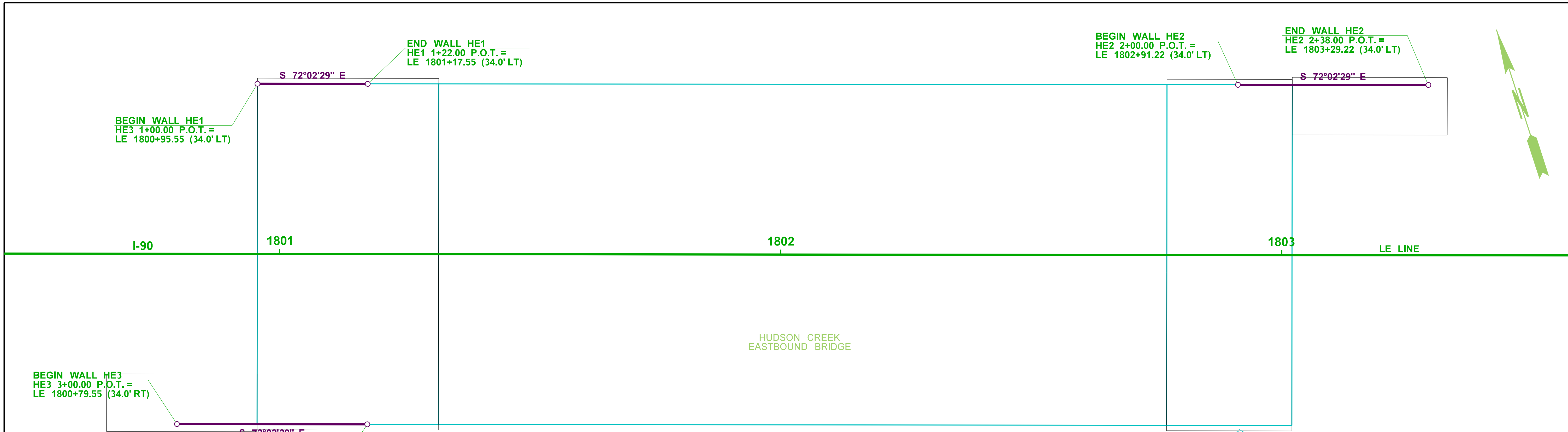
I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

HUDSON CRK
WALL PLAN AND PROFILE

Plot 5
PLAN REF. NO.
WS5
SHEET
OF
SHEETS



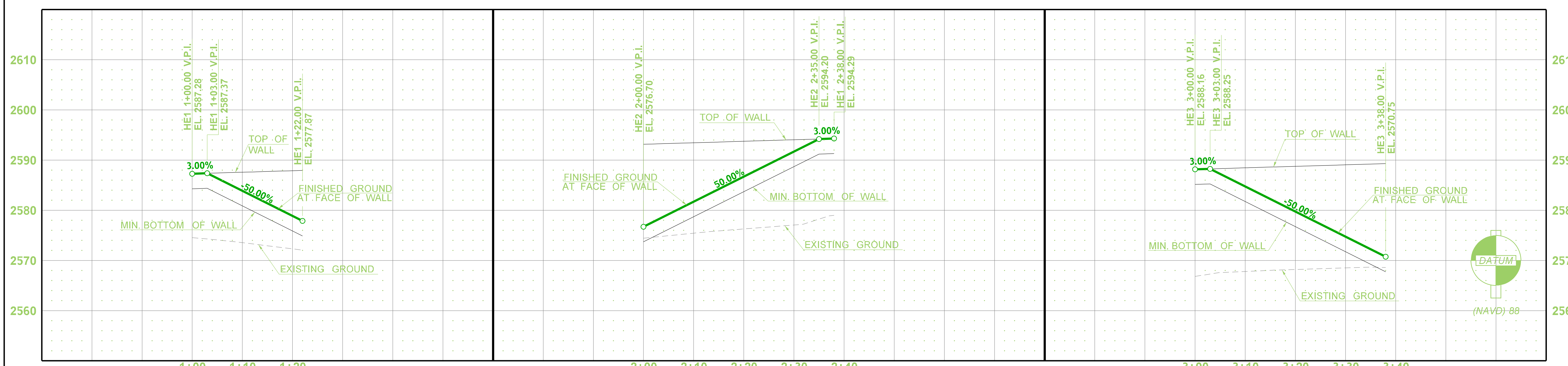
WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
HE1 1+00.00	2587.28'	2587.28'	2584.28'
HE1 1+03.00	2587.37'	2587.37'	2584.37'
HE1 1+22.00	2587.94'	2577.87'	2574.87'
HE2 2+00.00	2593.15'	2576.70'	2573.70'
HE2 2+35.00	2594.20'	2594.20'	2591.20'
HE2 2+38.00	2594.29'	2594.29'	2591.92'

0 10 20
SCALE IN FEET

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
HE3 3+00.00	2588.16'	2588.16'	2585.16'
HE3 3+03.00	2588.25'	2588.25'	2585.25'
HE3 3+38.00	2589.30'	2570.75'	2567.75'



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DATE	8/3/2021
PLOTTED BY	GipnerM
DESIGNED BY	M. GIPNER / K. KING
ENTERED BY	J. VENEGAS
CHECKED BY	K. KING
PROJ. ENGR.	A. BYRD
REGIONAL ADM.	T. TREPANIER

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10	WASH	

JOB NUMBER

CONTRACT NO. | LOCATION NO.

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Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

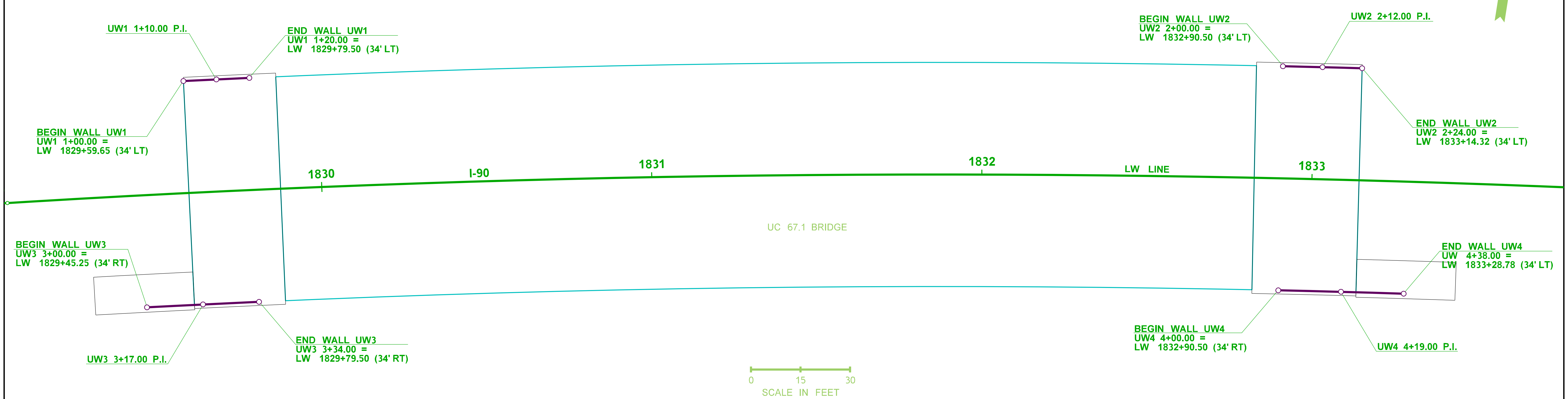
HUDSON CRK
WALL PLAN AND PROFILE

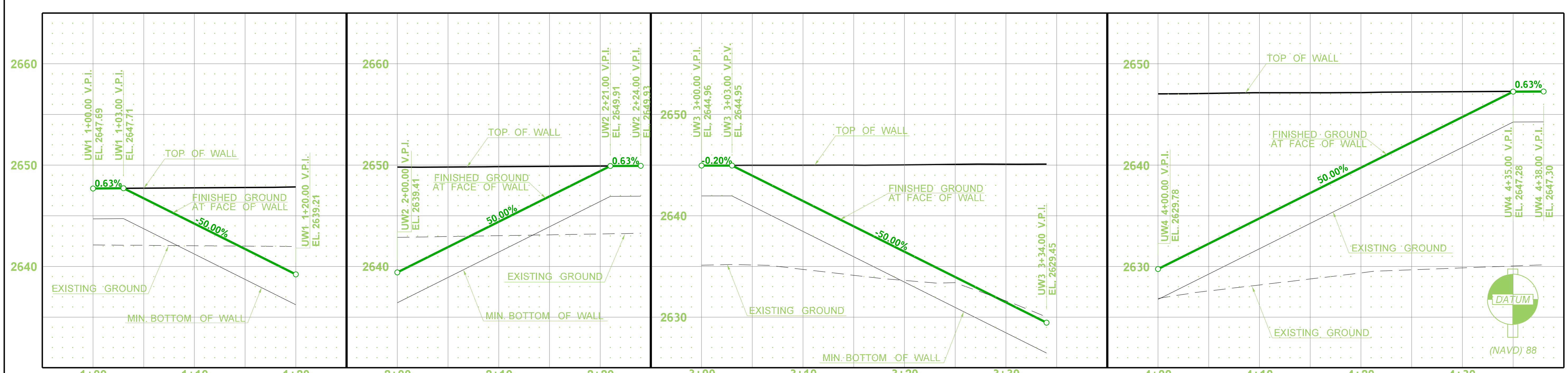
Plot 6
PLAN REF. NO.
WS6
SHEET
OF
SHEETS

CURVE DATA				
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH
UW1 1+10.00	0°14'49" RT	4,642'	3.09'	20'
UW2 2+12.00	0°17'46" RT	4,642'	12.00'	24'
UW3 3+17.00	0°25'33" RT	4,574'	17.00'	34'
UW4 4+19.00	0°28'34" RT	4,574'	19.00'	38'

WALL ELEVATIONS			
STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
UW1 1+00.00	2647.59'	2647.59'	2644.59'
UW1 1+03.00	2647.71'	2647.71'	2644.71'
UW1 1+20.00	2647.84'	2639.21'	2636.21'
UW2 2+00.00	2649.80'	2639.41'	2636.41'
UW2 2+21.00	2649.91'	2649.91'	2646.91'
UW2 2+24.00	2649.93'	2649.93'	2646.93'

WALL ELEVATIONS			
STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
UW3 3+00.00	2644.96'	2644.96'	2641.96'
UW3 3+03.00	2644.95'	2644.95'	2641.95'
UW3 3+34.00	2645.10'	2629.45'	2626.45'
UW4 4+00.00	2647.06'	2629.78'	2626.78'
UW4 4+35.00	2647.28'	2647.28'	2644.28'
UW4 4+38.00	2647.30'	2647.30'	2644.30'





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PLOTTED BY	GipnerM			
DESIGNED BY	M. GIPNER			
ENTERED BY	J. VENEGAS			
CHECKED BY	K. KING			
PROJ. ENGR.	A. BYRD			
REGIONAL ADM.	T. TREPANIER	REVISION	DATE	BY

REGION NO.	STATE	FED.AID PROJ.NO.
10	WASH	
JOB NUMBER		
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Washington State
Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

UC 67.1 CRK WALL PLAN AND PROFILE

Plot 7
PLAN REF. NO.
WS7
SHEET
OF
SHEETS

CURVE DATA

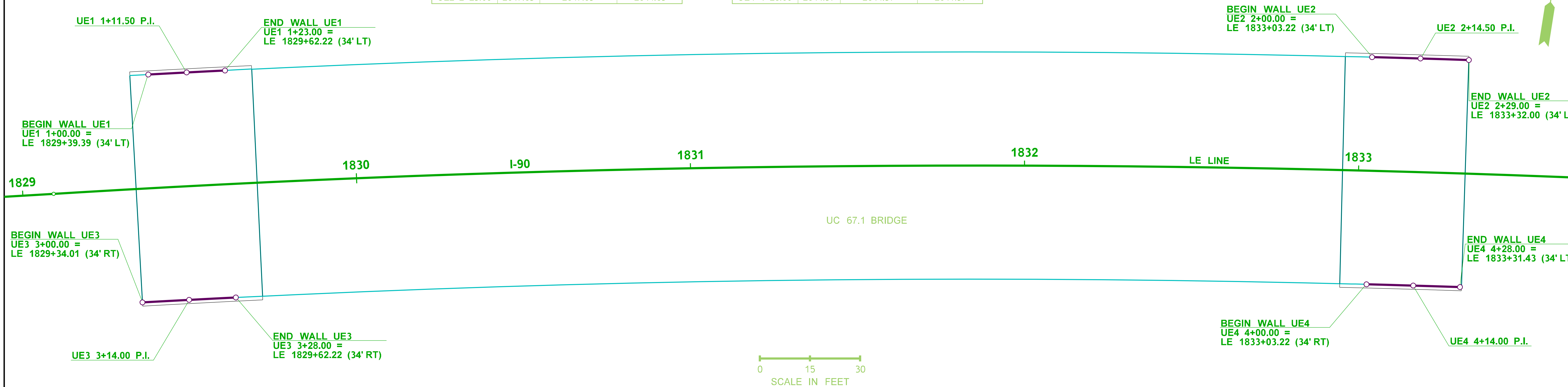
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH
UE1 1+11.50	0°17'26" RT	4,534'	11.50'	23'
UE2 2+14.50	0°21'59" RT	4,534'	14.50'	29'
UE3 3+14.00	0°21'33" RT	4,466'	14.00'	28'
UE4 4+14.00	0°21'33" RT	4,466'	14.00'	28'

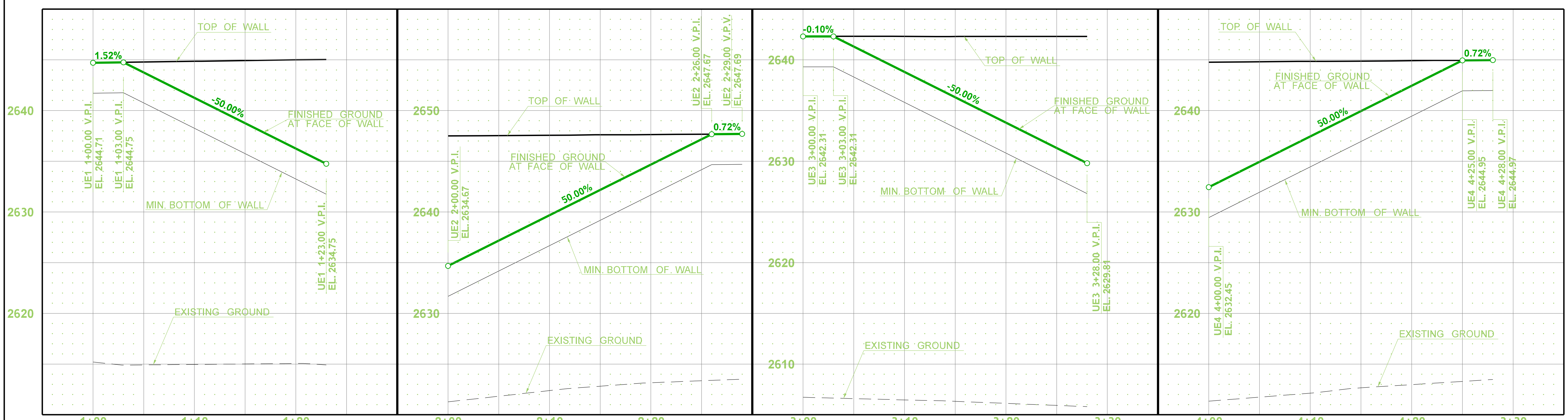
WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
UE1 1+00.00	2644.71'	2644.71'	2641.71'
UE1 1+03.00	2644.75'	2644.75'	2641.75'
UE1 1+23.00	2645.03'	2634.75'	2631.75'
UE2 2+00.00	2647.50'	2634.67'	2631.67'
UE2 2+26.00	2647.67'	2647.67'	2644.67'
UE2 2+29.00	2647.69'	2647.69'	2644.69'

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
UE3 3+00.00	2642.31'	2642.31'	2639.31'
UE3 3+03.00	2642.31'	2642.31'	2639.31'
UE3 3+28.00	2642.31'	2629.81'	2626.81'
UE4 4+00.00	2644.77'	2632.45'	2629.45'
UE4 4+25.00	2644.95'	2644.95'	2641.95'
UE4 4+28.00	2644.97'	2644.97'	2641.97'





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DATE	8/3/2021
PLOTTED BY	GipnerM
DESIGNED BY	M. GIPNER
ENTERED BY	J. VENEGAS
CHECKED BY	K. KING
PROJ. ENGR.	A. BYRD
REGIONAL ADM.	T. TREPANIER

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Washington State Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

UC 67.1 CRK WALL PLAN AND PROFILE

Plot 8

PLAN REF. NO. WS8

SHEET

OF

SHEETS

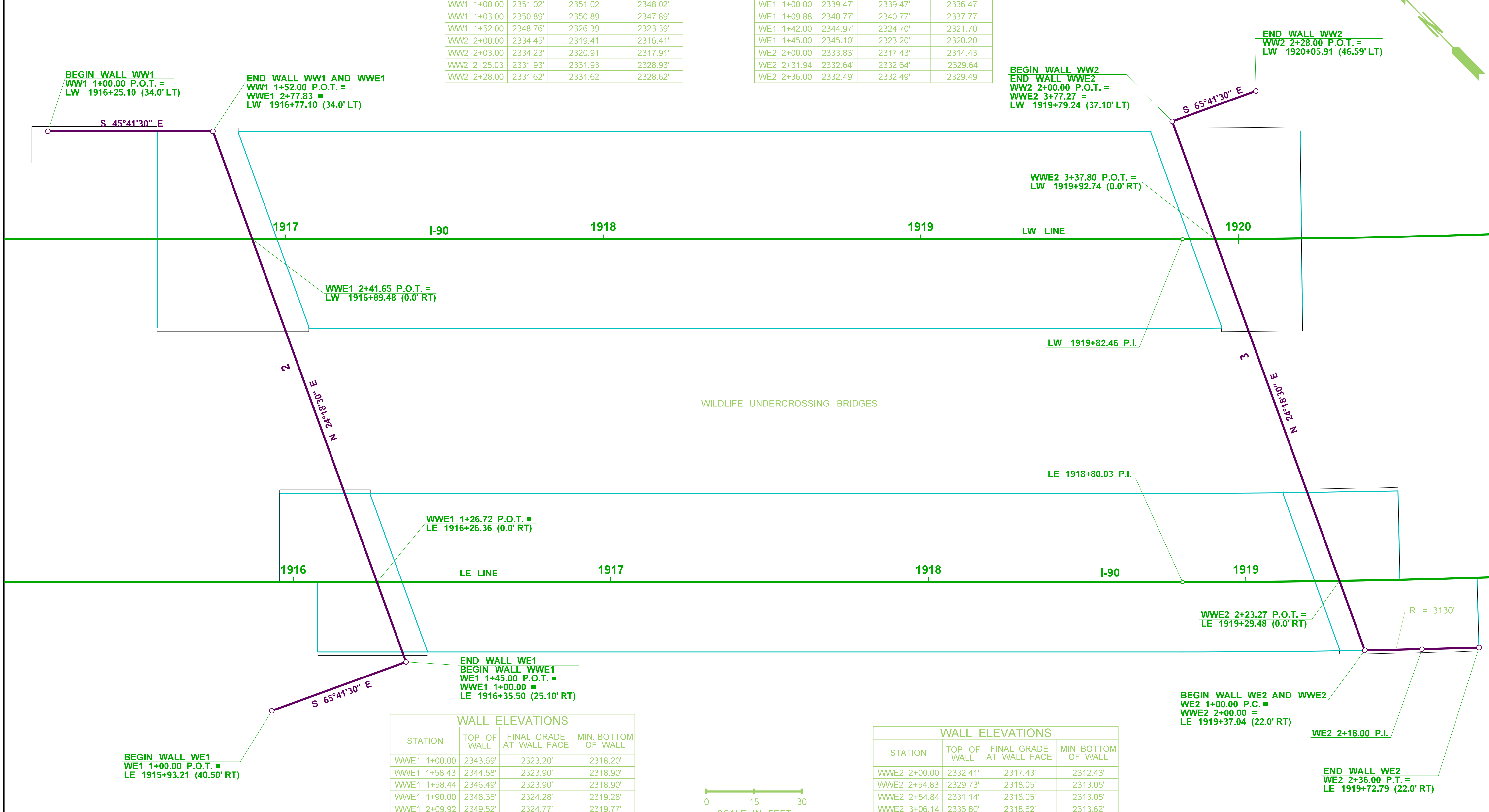
CURVE DATA				
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH
WE2 2+18.00	0°39'32" LT	3,130'	18.00'	36.00'

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
WW1 1+00.00	2351.02'	2351.02'	2348.02'
WW1 1+03.00	2350.89'	2350.89'	2347.89'
WW1 1+52.00	2348.76'	2326.39'	2323.39'
WW2 2+00.00	2334.45'	2319.41'	2316.41'
WW2 2+03.00	2334.23'	2320.91'	2317.91'
WW2 2+25.03	2331.93'	2331.93'	2328.93'
WW2 2+28.00	2331.62'	2331.62'	2328.62'

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
WE1 1+00.00	2339.47'	2339.47'	2336.47'
WE1 1+09.88	2340.77'	2340.77'	2337.77'
WE1 1+42.00	2344.97'	2324.70'	2321.70'
WE1 1+45.00	2345.10'	2323.20'	2320.20'
WE2 2+00.00	2333.83'	2317.43'	2314.43'
WE2 2+31.94	2332.64'	2332.64'	2329.64
WE2 2+36.00	2332.49'	2332.49'	2329.49'



WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
WWE1 1+00.00	2343.69'	2323.20'	2318.20'
WWE1 1+58.43	2344.58'	2323.90'	2318.90'
WWE1 1+58.44	2346.49'	2323.90'	2318.90'
WWE1 1+90.00	2348.35'	2324.28'	2319.28'
WWE1 2+09.92	2349.52'	2324.77'	2319.77'
WWE1 2+09.93	2347.60'	2324.77'	2319.77'
WWE1 2+77.83	2347.34'	2326.44'	2321.44'

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
WWE2 2+00.00	2332.41'	2317.43'	2312.43'
WWE2 2+54.83	2329.73'	2318.05'	2313.05'
WWE2 2+54.84	2331.14'	2318.05'	2313.05'
WWE2 3+06.14	2336.80'	2318.62'	2313.62'
WWE2 3+06.15	2335.38'	2318.62'	2313.62'
WWE2 3+77.27	2333.04'	2319.42'	2314.42'

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DATE	8/3/2021
PLOTTED BY	GipnerM
DESIGNED BY	M. GIPNER / K. KING
ENTERED BY	J. VENEGAS
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PROJ. ENGR.	A. BYRD
REGIONAL ADM.	T. TREPANIER

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REGION NO. 10 | STATE WASH | FED.AID PROJ.NO.

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CONTRACT NO. | LOCATION NO.

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I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES
WILDLIFE UNDERCROSSING WALL PLAN

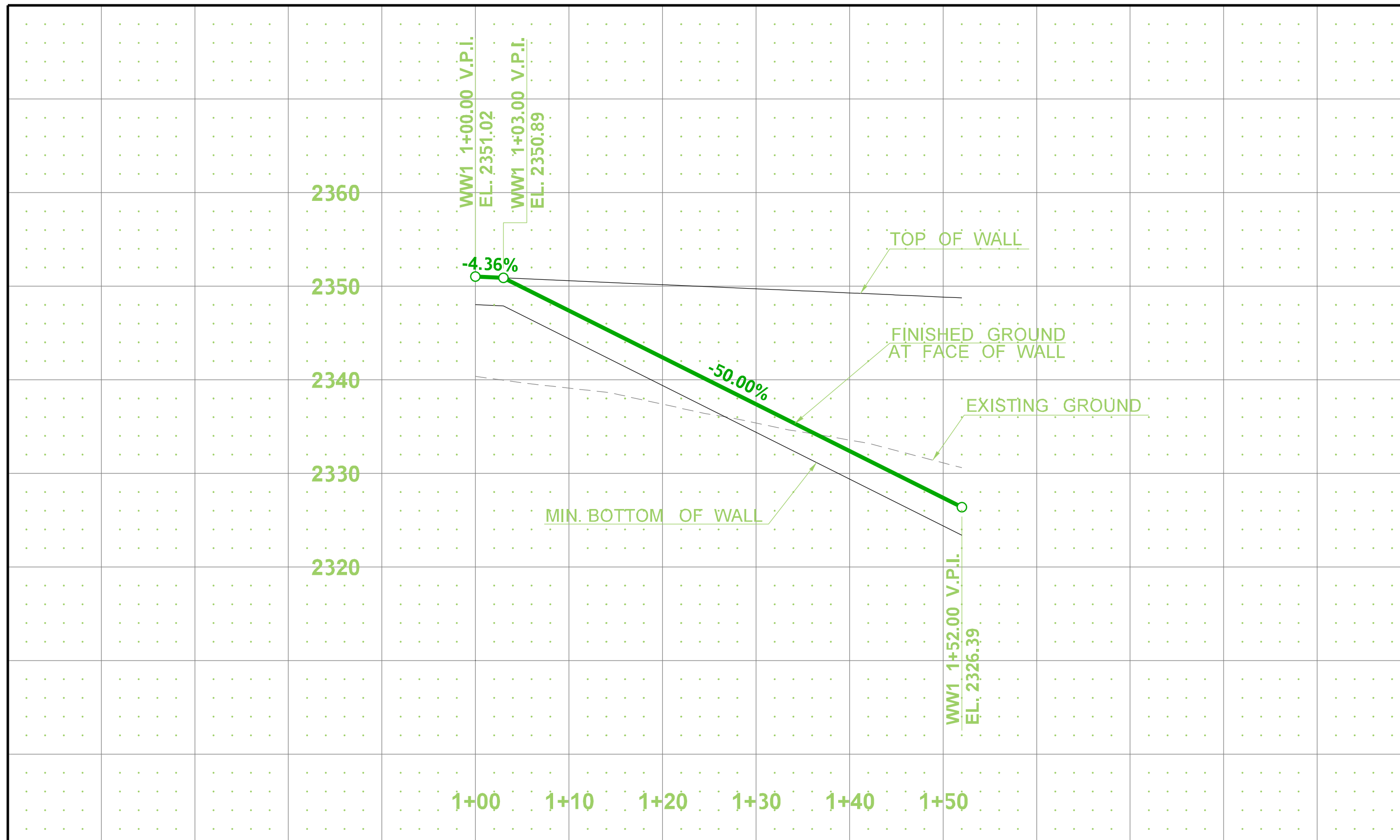
Plot 9

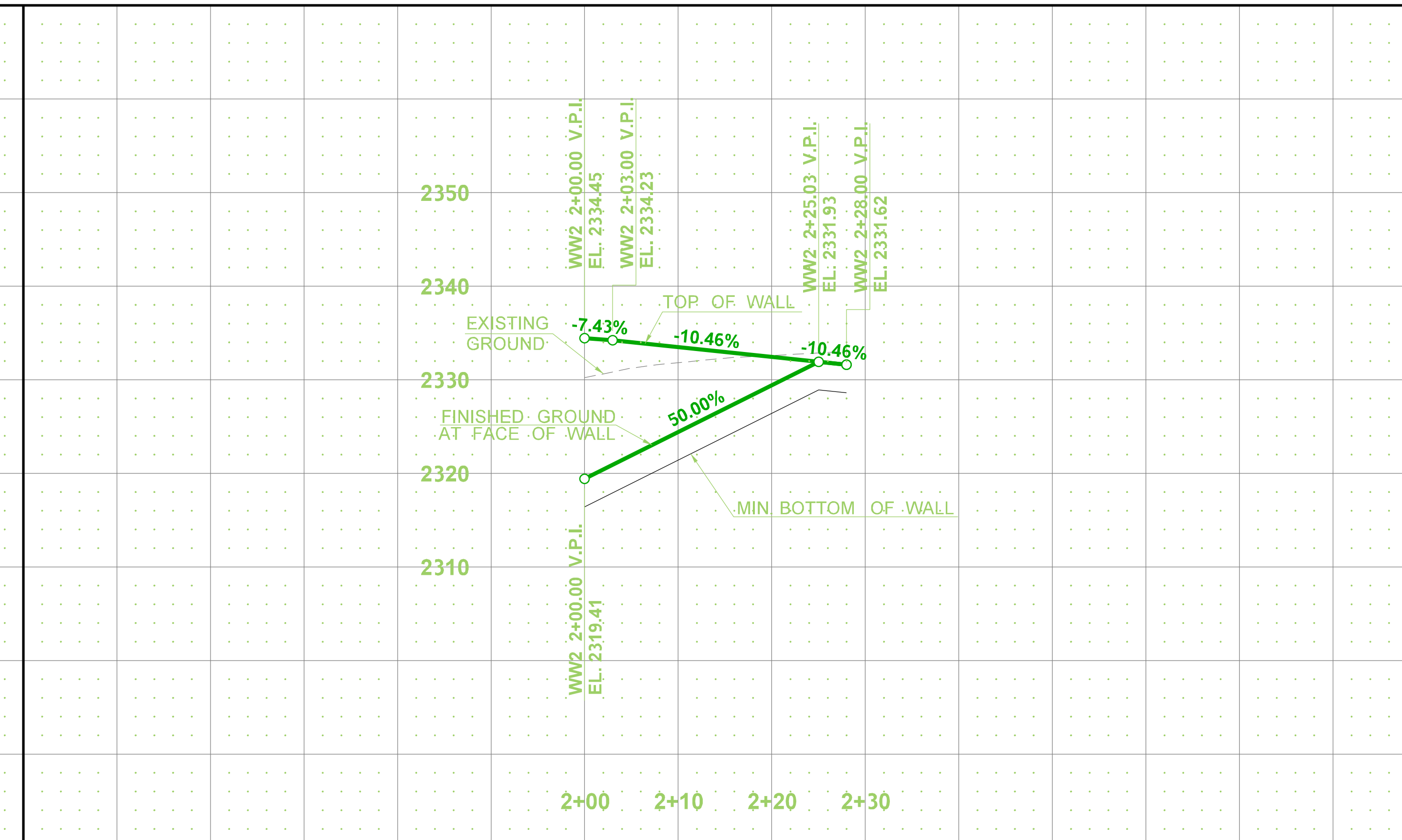
PLAN REF NO WS9

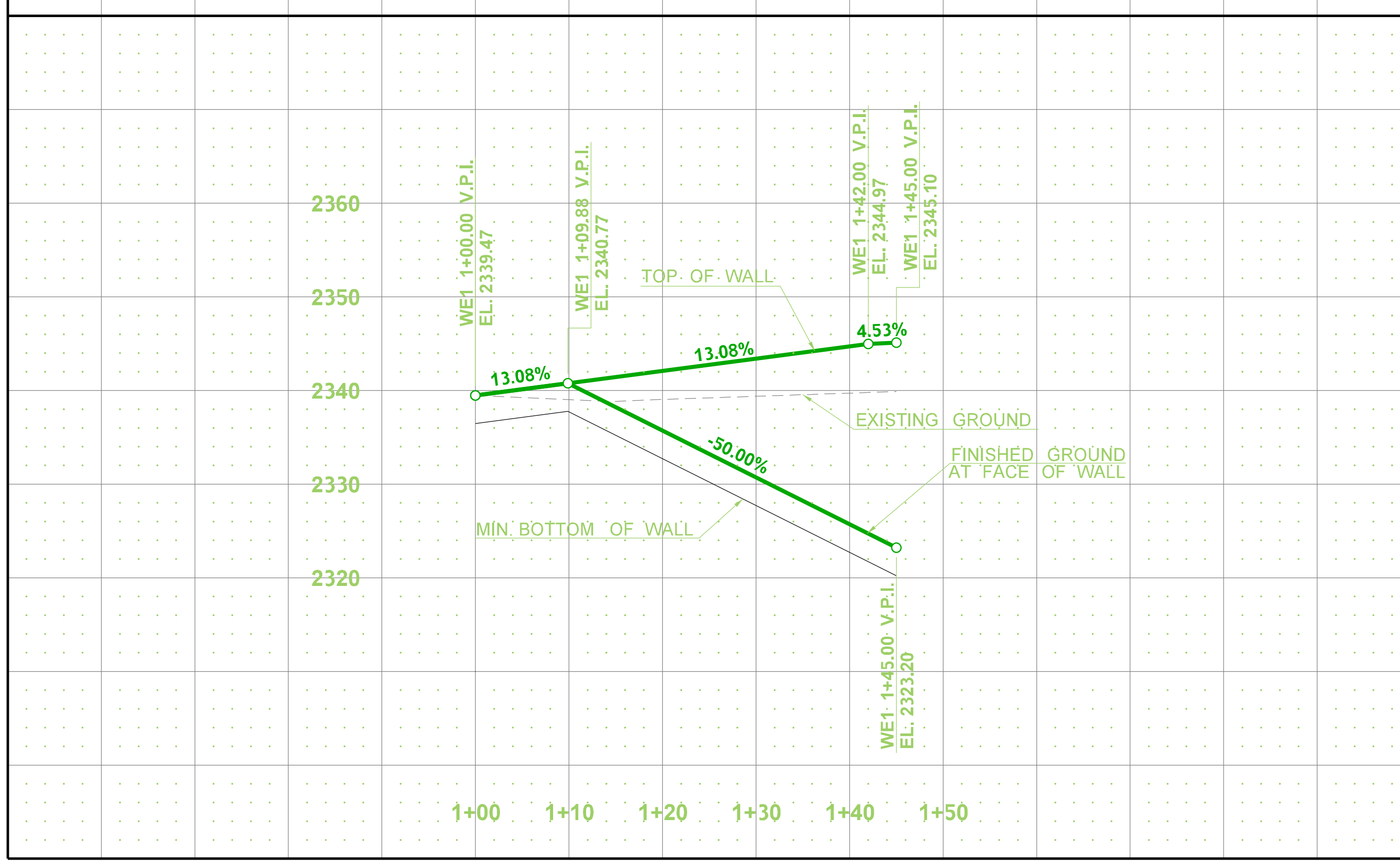
SHEET

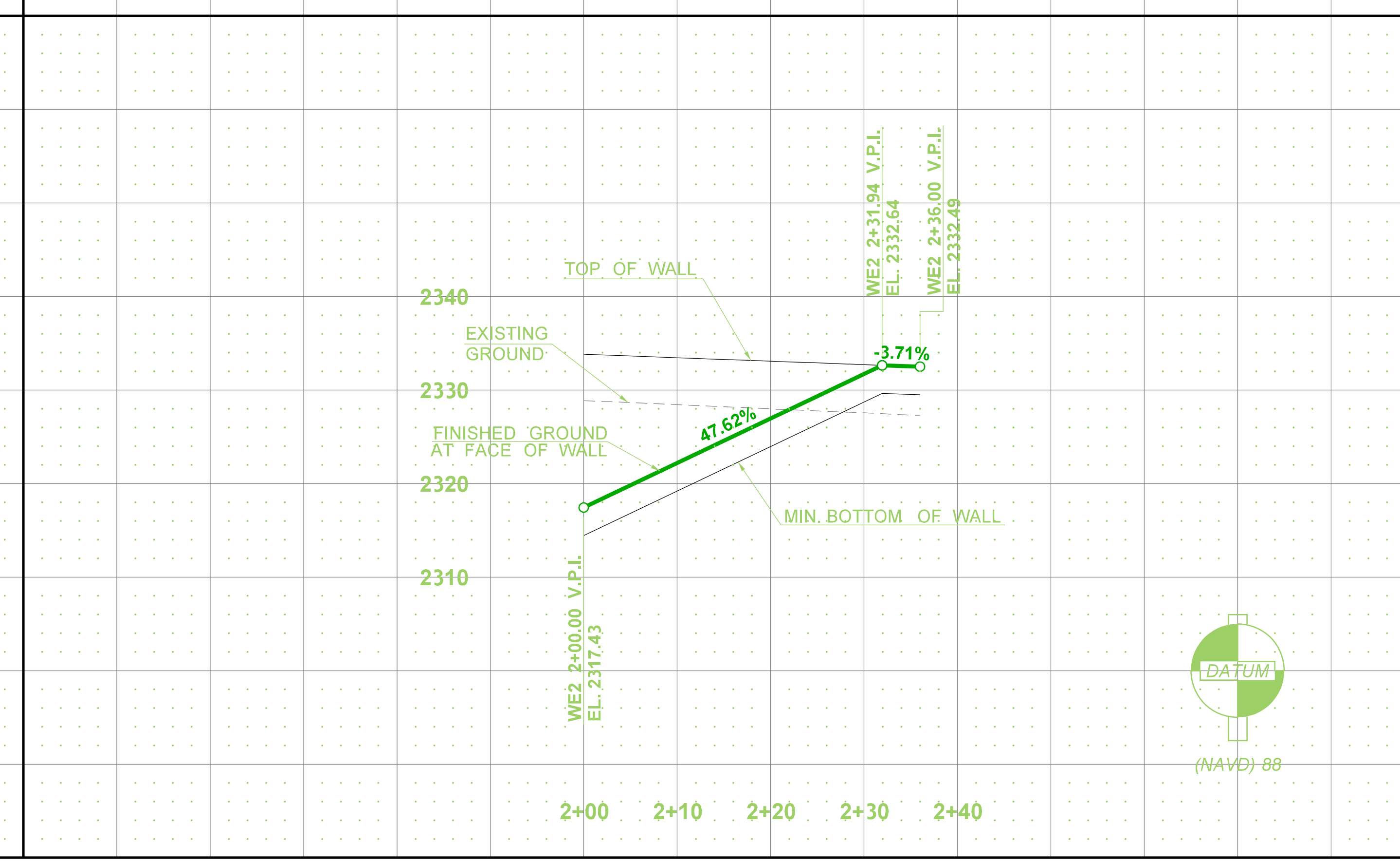
OF

SHEETS









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DATE	8/3/2021			
PLOTTED BY	GipnerM			
DESIGNED BY	M. GIPNER / K. KING			
ENTERED BY	J. VENEGAS			
CHECKED BY	K. KING			
PROJ. ENGR.	A. BYRD			
REGIONAL ADM.	T. TREPANIER	REVISION	DATE	BY

REGION NO.	STATE	FED.AID PROJ.NO.
10	WASH	
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Washington State
Department of Transportation

I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

WILDLIFE UNDERCROSSING
WALL PROFILE

Plot 10
PLAN REF. NO.
WS10
SHEET
OF
SHEETS

CURVE DATA

P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH
SW1 1+23.00	0°53'19" LT	2,966'	23.00'	46'
SW2 2+15.00	0°34'46" LT	2,966'	15.00'	30'
SE1 1+26.50	0°58'13" LT	3,130'	26.50'	53'
SE2 2+21.00	0°46'08" LT	3,130'	21.00'	42'

WALL ELEVATIONS

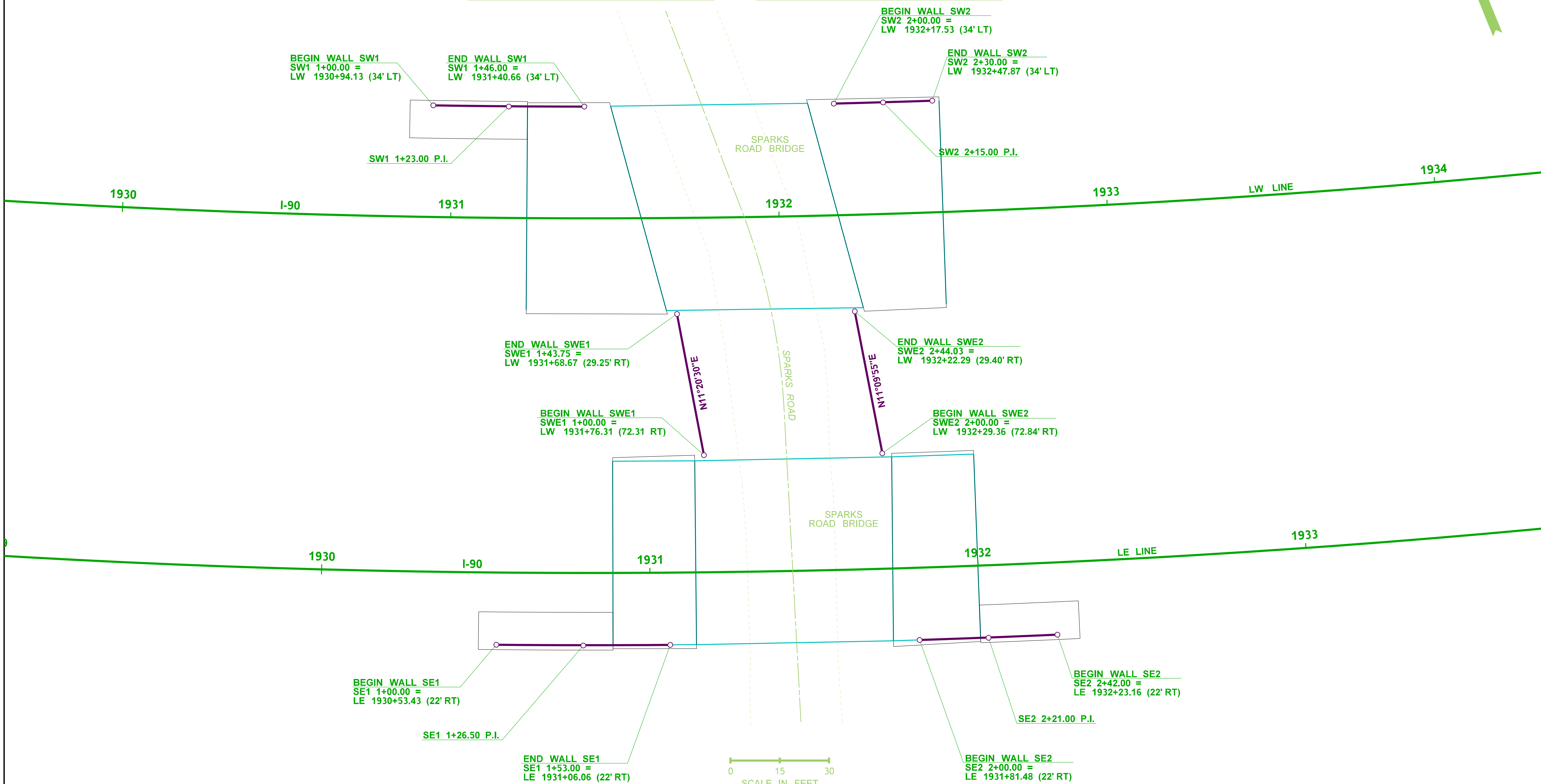
STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
SW1 1+00.00	2285.27'	2285.27'	2282.27'
SW1 1+03.00	2285.14'	2285.14'	2282.14'
SW1 1+32.00	2283.24'	2263.64'	2260.64'
SW2 2+00.00	2279.89	2265.20'	2262.20'
SW2 2+27.00	2278.70'	2278.70'	2275.70'
SW2 2+30.00	2278.57'	2278.57'	2275.57'

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL
SE1 1+00.00	2286.86'	2286.86'	2283.86'
SE1 1+03.00	2286.73'	2286.73'	2283.73'
SE1 1+53.00	2284.64'	2261.73'	2258.73'
SE2 2+00.00	2281.44'	2260.30'	2257.30'
SE2 2+39.00	2279.80'	2279.80'	2276.80'
SE2 2+42.00	2279.68'	2279.68'	2276.68'

WALL ELEVATIONS

STATION	TOP OF WALL	FINAL GRADE AT WALL FACE	MIN. BOTTOM OF WALL	FINAL GRADE AT DITCH BOTTOM
SWE1 1+00.00	2279.56'	2258.45'	2252.75'	2256.46'
SWE1 1+47.75	2286.45'	2259.63'	2255.00'	2257.62'
SWE2 2+00.00	2277.28'	2258.41'	2253.73'	2256.37'
SWE2 2+44.03	2284.12'	2259.44'	2255.90'	2257.43'



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PLOTTED BY	GipnerM		
DESIGNED BY	M. GIPNER / K. KING		
ENTERED BY	J. VENEGAS		
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PROJ. ENGR.	A. BYRD		
REGIONAL ADM.	T. TREPANIER		
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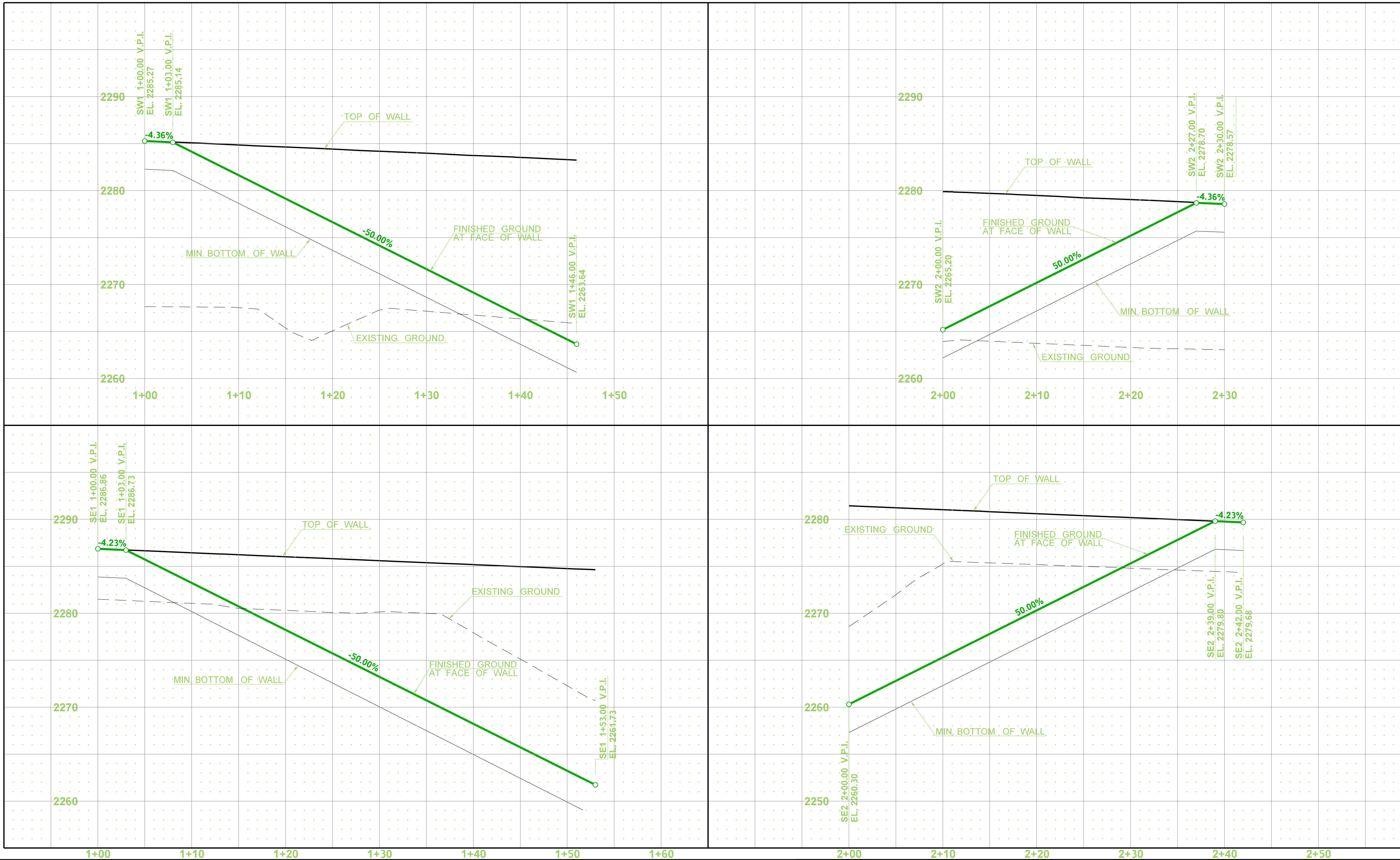
I-90
CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES
SPARKS ROAD WALL PLAN

Plot 12
PLAN REF NO
WS12
SHEET
OF
SHEETS



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DATE	8/3/2021
PLOTTED BY	GipnerM
DESIGNED BY	M. GIPNER / K. KING
ENTERED BY	J. VENEGAS
CHECKED BY	K. KING
PROJ. ENGR.	A. BYRD
REGIONAL ADM.	T. TREPANIER

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CABIN CREEK I/C TO W. EASTON I/C
PHASE 3 - ADD LANES/BUILD WILDLIFE BRIDGES

SPARKS ROAD WALL PROFILE

Plot 13

PLAN REF. NO. WS13

SHEET OF SHEETS